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IN THE CIRCUIT COURT
OF THE ELEVENTH JUDICIAL CIRCUIT
IN AND FOR DADE COUNTY, FLORIDA
GENERAL JURISDICTION DIVISION

HOWARD A. ENGLE, M.D., et al.,

Plaintiffs,

vs.

R.J. REYNOLDS TOBACCO COMPANY, ETC., et al.,

Defendants.

CASE NO. 94-08273CA20

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DEPOSITION OF

LANCE REYNOLDS

December 9, 1997

10:30 a.m.

191 Peachtree Street
50th Floor
Atlanta, Georgia

Renda K. Cornick, CCR-B-909, RPR

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LANCE REYNOLDS,

having been first duly sworn, was examined and testified as follows:

CROSS-EXAMINATION

BY MR. HOAG:

Q. We have met over the phone at least once before, so I know you have done at least one telephone deposition before. Have you done any depositions since the deposition that was taken in the Broin case?

A. I think so. I stand to be corrected on the dates, but I believe I had another deposition in the Minnesota Attorney General suit which I believe was after the Broin deposition.

Q. Did you testify live at the Broin trial?

A. No.

Q. You were scheduled to testify but that didn't get that far; is that right?

A. I am not even sure if I was scheduled to testify. I don't know.

Q. Because, seriously, I couldn't recollect whether you testified live or not.

How many times have you testified in --

A. You mean live at trial in court?

Q. Right.

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A. None in connection with any of the smoking health litigation, only in the patent infringement lawsuit at the beginning of the year in Louisville, Kentucky.

Q. Beginning of '97?

A. Yeah.

Q. You said your recollection is you were going to testify in the Minnesota Attorney General suit after you were deposed in Broin.

A. That's my recollection of the dates, yeah.

Q. Approximately when?

A. I think it was about the end of September.

Q. How long did that deposition take?

A. Basically a day.

Q. Who took that deposition?

A. Martha Wivell.

Q. The testimony you gave in the Minnesota case, was it basically the same type of thing you expect to testify about in the Engle case?

A. Well, I expect to testify about my areas of expertise which is basically product development at Brown & Williamson from the late '60s on up until the time I retired. What goes into cigarettes.

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Q. What year did you retire?
A. '91.
Q. I am sorry for the delay. I am looking for a certain document. I will be right with you.
You have a consulting agreement with Brown & Williamson, right?
A. Correct.
Q. What is that? What is the nature of that agreement?
A. Well, I think I sent it to you or you asked for it to be sent at my last telephone deposition with you. I have to assume it was sent. Basically it is a contract in which I would provide 60 days' consulting service for $75,000 and it runs through, I think, the year 2001.
Q. And you provided that each year, up to 60 days of consulting for $70,000 for each year?
A. $75,000.
Q. $75,000 each year?
A. Yes.
Q. If you go over 60 days, how much more is your compensation?
A. Prorated, $1250 a day.
Q. $1250 a day, correct?
A. Correct.

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Q. And if you only work ter days of consulting in a given year, how much do you receive?

A. $75,000.

Q. Now, is that an exclusive agreement? By that I mean are you allowed to do any other consulting work?

A. Not for anybody associated with the tobacco industry, but I can and do do other consulting work for other industries in other areas.

Q. Would you be allowed to act as a consultant for someone suing a tobacco company if you wanted to?

A. No, I don't think so.

Q. When did you first start to go to work for a tobacco company?

A. It was for Imperial Tobacco Company in England in 1964.

Q. What did you do?

A. I worked on development of cigarette filters.

Q. How long did you do that?

A. About two years.

Q. And do you have a Ph.D?

A. No. A bachelor's and master's degree in chemistry. Don't have a Ph.D.

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Q. What year did you get your master's degree in chemistry?

A. I finished working on it in '62, but I think the degree was given in '63.

Q. Have you ever done any research concerning the health effects of cigarette or tobacco smoke?

A. I think we need to define what we are talking about. But if you are -- well, perhaps you care to define it and I can tell you whether I have done it or not.

Q. How do you define the term health effects?

A. Well, I will define a health effect as a disease condition, but that seems like a circular definition so I am not sure we are getting anywhere.

Q. Do you have a definition for health effects?

A. Well, I guess sort of a common sense definition that if one's health is affected by something, then one is not in normal good health.

Q. Using your definition, your common sense definition of health effects, have you ever done any research on the health effects of cigarettes or tobacco --

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MR. HOFFMANN: I object to the form of the question to the extent research is vague. It is not clear whether you mean original research or whether he reviewed literature.

Q. (By Mr. Hoag) You can answer it.

A. I have read a considerable amount of literature on health effects alleged to be associated with smoking. I have not done hands-on research, for example, mouse skin painting if that is the kind of thing you are talking about.

Q. Have you done any hands-on research related to health effects of tobacco smoking?

A. Not on the biological effects of tobacco smoking on any organisms, no, I haven't.

Q. When you say biological effects of tobacco smoke, what are you talking about?

A. Well, there are a number of tests that have been used over the years to determine if substances both from tobacco smoke, foods, alcoholic beverages can affect the biochemistry of cells or the tissues of animals as I mentioned earlier. Mouse skin painting is one example. There are examples on little single-cell animals called paramecia to see if their motility is affected by tobacco smoke. Those are the kinds of things I am

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talking about.

Q. How many days are you up to now on your consulting agreement for 1997?

A. Well, the fiscal year, if you like, runs from July of '96 to July of '97 so to give you a straight answer, during the calendar year '97 I have probably worked about 75 or 80 days in total for Brown & Williamson.

Q. But when you say the fiscal year, the fiscal year is what you use to calculate the compensation under your consulting agreement?

A. Yes.

Q. For fiscal year beginning in July of '96 going to July of '97, how many days did you spend consulting?

A. I think probably around 80.

Q. So your compensation for that fiscal year, July '96 to July '97, was $75,000 plus 20 days at $1250; is that correct?

A. Yep.

Q. Do you receive any other, during that fiscal year, did you receive any other compensation from the tobacco company?

A. I get a pension. I don't know if you define that as compensation or not.

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Q. How much is your pension?
A. About $40,000 a year.
Q. Any other compensation in addition to your pension?
A. Nope.
Q. Did you work exclusively for Brown & Williamson as far as tobacco companies that you worked for? I know you said Imperial. Did you work exclusively for Brown & Williamson in the United States?
A. That is correct, yes.
Q. How many years did you spend working for Brown & Williamson?
A. From beginning of '68 to '91, about 23 years.
Q. Do any of the -- well, let me back up. How many compounds, approximately, are there in cigarettes and/or cigarette smoke?
A. Well, in tobacco I think the count is of the order of 4,000 that have been identified. In tobacco smoke I think it is of the order of 10,000.
Q. Have you ever heard of the term synergistic?
A. Yes.
Q. What does that mean to you?

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A. That when two or more things are acting together, the whole is greater than the sum of the parts.

Q. Do any of the compounds found in tobacco have a synergistic effect upon one another?

A. Could you rephrase that again. I don't quite understand what you are asking me.

Q. Let me use an example. Have you read, are you familiar with any of the research on asbestos and tobacco smoke?

A. Not in any detail at all, no.

Q. Are you familiar with research if not in detail that shows that cigarette smoke and asbestos acting together have a synergistic effect?

A. I have heard it suggested they may. I have never like reviewed the literature to convince myself one way or another whether they do or not. I don't know, but I understand what you are saying.

Q. Do any of the compounds, I mean, understanding that you don't know whether or not it is true that asbestos and cigarette smoke have a synergistic effect, do you know whether any of the compounds in tobacco smoke within themselves acting together has a synergistic effect?

A. I assume you are asking about a health

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effect, adverse health effect.

Q. Well, now I am just asking about a synergistic effect.

A. Well, if you are just asking about a synergistic effect, for example I think ammonia reacts with aldehydes in the vapor phase of smoke and they form something else. In that case the whole is lesser than the sum of the parts because I think there might be some slight reduction in the strength. That would be an antisynergism.

Q. Anything else you can think of other than antisynergism?

A. No.

Q. When you say ammonia acts with aldehydes, what are aldehydes?

A. They are a class of chemicals that have what is called an aldehydric group which is at the end of the molecules there is a carbon atom which has attached to it an oxygen atom and a hydrogen atom.

Q. What are examples of some aldehydes that are in tobacco?

A. It is hard for me to say in tobacco smoke, it is easier for me to say --

Q. Okay. In tobacco smoke?

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A. Acetaldehyde, crotonaldehyde butylaldehyde, formaldehyde, acroleinaldehyde.

Q. Anything else?

A. Well, probably valeraldehyde. There are lots of aldehydes.

Q. So you said ammonia interacts with aldehydes.

A. It appears to react with some of them, yeah.

Q. What does ammonia do as it interacts with these aldehydes? What is its effect?

A. Well, it forms a compound called acetaldehyde.

Q. What does that compound do, if anything?

A. Don't think it does anything.

Q. You said the ammonia -- I think you said the ammonia interacts with the aldehydes in the vapor phase and it is an antisynergism. How does this ultimately result in an antisynergism?

A. Resulting in acrolein which is irritating in the tissues of the mouth.

Q. Is that your whole answer?

A. No. I was waiting until you were ready.

So the sum of the reaction between acrolein and ammonia I think, I am now beginning to

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wonder about my chemistry, I think basically this is a reaction between acrolein and ammonia, so the acrolein was there giving some irritation to the mouth has now reacted to form a new compound and it is not irritating.

Let me give you another example here because I think we are both struggling a little bit. The simple one is metal sodium is very reactive, chlorine is a very toxic gas. Together they make sodium chloride which many of us put on food and is vital to life.

When chemicals react together, the new chemicals just have a totally different property than the old one.

Q. So when you add one chemical to another it can totally alter both chemicals; is that true?

A. Yeah, yeah.

Q. Now, does the ammonia -- ammonia is in cigarettes, correct?

A. Well, there is some ammonia compounds naturally in tobacco, yeah; and so, yeah, there is ammonia produced in cigarette smoke when tobacco is burned.

Q. Is it possible to remove the ammonia from the cigarette?

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A. Well, let me try and -- are we talking about cigarettes or cigarette smoke?

Q. Well, if somebody wanted to do it, if one of the tobacco companies wanted to remove the ammonia from the tobacco and ultimately from the smoke, would they be able to do that?

A. Well, probably not because some of the ammonia in the smoke I think comes when various proteins and ammonia acids that are in tobacco get burned. So the ammonia itself is a product of combustion of other chemicals in part.

Q. So you would have to remove some of the other chemicals to stop the ammonia from forming; is that what you are saying?

A. I think what I am saying is if you have a piece of paper which doesn't contain any nitrogen compounds -- sort of like a piece of pure cellulose -- and burned it, you wouldn't get any ammonia. If you burn a tobacco leaf or a corn husk or almost any vegetable material you will get some ammonia in the smoke event.

Q. You get how much, do you know?

A. Tobacco, under the standard methods, you get about 70 micrograms; from the corn husk, I don't have a clue.

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Q. So that is 70 micrograms you get of ammonia, you get that ammonia from burning the cigarette, right?

A. Burning the tobacco.

Q. Can you reduce the amount of ammonia in the tobacco that has formed as a result of burning tobacco or is that just not possible?

A. I think you probably could reduce it if you put an acidic filter on the cigarette. I don't know why anyone would particularly want to.

Q. An acidic filter, what is that?

A. Well, it would be a filter that would have an acidic material on it, like citric acid.

Q. Like in orange juice you mean?

A. Yeah.

Q. If you added that to a filter, you could remove some of the ammonia from the tobacco smoke, if you wanted to?

A. I think you probably could, yeah.

Q. About how much of the ammonia would it remove?

A. I don't know. I have never done that experiment.

Q. Other than naturally occurring ammonia, what occurs in tobacco when it is burned? Is

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ammonia ever added to cigarettes to your knowledge?

A. Ammonia compounds such as diammonium phosphate.

Q. Any others?

A. Urea. Those are the two I am most familiar with.

Q. And what does that raise the level of ammonia to, once tobacco is burned?

A. I don't know precise figures, but it is not a huge difference. It might be like if you didn't have any ammonia it might be 40 micrograms ammonia compounds. If you had ammonia compounds it might be 70. If it was 70 without it might be a hundred but it is that sort of change.

If you want the numbers very much, I am sure they could be provided through some attorneys. I don't know off the top of my head what they are.

Q. That's the kind of things the attorneys would have?

A. They could get it for you. I don't think it is the kind of thing they have, either. I think they would ask the client to provide the data to you.

MR. HOFFMANN: Let me state the attorneys in this room do not have this

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information. If you wish to serve an interrogatory requesting that information we will respond to it, but we would obviously have to get the information from the client. It is not something we would have ourselves.

MR. HOAG: I understand that. Right now at least for today what I want to find out from this witness is what he knows. He has given me the information that he has available to him regarding the ammonia.

Q. (By Mr. Hoag) So to summarize, the substances that are added in increase the ammonia level but by your estimate they don't quite double the ammonia level, is that correct?

A. That is correct. My recollection is they increase it to the order of 30 to 50 percent but that is a rather fuzzy recollection.

Q. And why is that done? Is the ammonia level increased 30 to 50 percent?

A. Well, the ammonia level increases that amount but that's a by-product of the use of ammonia compounds I talked about being added to react with sugars which are naturally present in the tobacco to form flavorful compounds. That is really the driving force for adding the ammonia compounds, to

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produce flavorful compounds in smoking.

Q. When you say flavorful compounds, let me break it down if I can. Do these flavorful compounds you are talking about reduce irritation in some way?

A. In and of themselves, I don't think so. They just would sort of have a nutty flavor or chocolaty flavor or spicy flavor. But the perception of irritation is influenced in part by the flavor of the cigarette so it is very difficult for me to give a precise answer but just in and of themselves they don't change your absolute irritation.

Q. You said that the ammonia does have an effect on irritation or it decreases irritation when it becomes mixed with acrolein?

A. It appears to, yes. They sort of scavenge irritating compounds in the smoke.

Q. Is there anything that you are aware of in nicotine that smokers find irritating?

A. I think it depends on the amount of nicotine. But the level of nicotine that is typically in cigarette smoke, in the -- I don't think the nicotine is particularly responsible for any irritant sensation particularly.

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Q. Is there any level that you are aware of where the nicotine would be responsible for some irritating or irritant sensation?

A. Yeah. I think that if -- this is just kind of a rough estimate, but if you have had twice as much as you would normally have it would appear to be irritating and -- yeah.

Q. What is the normal amount of nicotine in a cigarette?

A. Well, we are talking in the tobacco or in the smoke?

Q. In the smoke.

A. Well, in the smoke there is a range of nicotine, this is on a per cigarette basis in the U.S. market from about a tenth of a milligram to about one-half milligram on average, if you took the sales weight average of all the cigarettes sold, I think it is slightly less.

Q. Now, that one-tenth of a milligram you are talking about, that's based on machine measurements; is that correct?

A. That's correct.

Q. Not based on actual human inhalation patterns concerning their inhalation of the nicotine, correct?

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A. Correct.

(Outside interruption.)

(The record was read by the reporter.)

Q. (By Mr. Hoag) Now, you know that the machine measurement of nicotine level doesn't accurately reflect the actual amount of nicotine a human being gets when a human being actually puffs on a cigarette, correct?

MR. HOFFMANN: Object the form of the question.

You may answer.

THE WITNESS: When the Federal Trade Commission published the method in 1968 they said this is a standard method for comparing the amount of smoke that comes out of cigarettes, it is not meant to represent what human beings get. So the Federal Trade Commission said that 39 years ago, 29 years ago, 39 years ago.

Q. (By Mr. Hoag) Your own studies from Brown & Williamson clearly establish given human puffing patterns are different, excuse me, human inhalation patterns are different from the amount of smoke that registers on the machine, correct?

A. As a very sort of enormously broad

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question. There has been a great deal of work done in this area trying to determine how much smoke human beings actually get and there is enormous variation between people and then within a person they might take two or three puffs on one cigarette, they might take ten or 12 puffs on a cigarette. The sort of summary of 30 years' research in this area, both inside and outside the industry, might best take away from it is on average rather surprisingly perhaps in view of the FTC disclaimer, the machine numbers are not that far off from what human beings get. But as I said, any particular person on any particular occasion could get more or less than the machine gets.

Q. When you say not that far off, what do you mean?

A. Well, that some of the published literature I have seen is saying that on average people tend to get about a milligram of nicotine out of a cigarette typically sold on the U.S. market and the sales weighted average of the nicotine delivery from a cigarette by the FTC method is around 1 milligram.

Q. Is there any average that shows an average smoker gets one-tenth of a milligram of

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nicotine per cigarette?

A. Well, you know, average smoker, taking the global average of the United States smokers, sales weighted average of those is around a milligram and the take away from most of the literature I have seen is that on average smokers take around a milligram from a cigarette. So if the sales weighted average is around a milligram and what outside research finds is around a milligram on average, then that is what the average is.

Q. Is it possible to get a milligram of nicotine from a cigarette that is labeled as one-tenth milligram?

A. I think if you broke the filter off, yes.

Q. What if you didn't break the filter off and just inhaled more deeply, could you get a full milligram from the nicotine from a cigarette that has one-tenth of a milligram?

A. It is not so much inhaling deeply as how many puffs you take. I think it would be very hard, but I don't know. I mean, I think, I think it is possible; but it would take some extra effort, as it were.

Q. What brands of cigarettes have one-tenth of a milligram of nicotine for cigarettes?

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A. Carlton, at lease some versions of Carlton; some versions of Now.

Q. What is it called?

A. Now, N-o-w.

And I am not up to date with what other brands of cigarettes out there are in the marketplace as of today. At the time I was working those were the two brands that by the standard smoking method at any rate gave a tenth of a milligram of nicotine by the standard method.

Q. Were either of those brands tested on humans to see how, I guess, close they come to that one-tenth of a milligram of nicotine?

A. Yes.

Q. What were the results of those studies?

A. Well, there is one, there is a study published by D[illegible]ori sometime in the 1980s; and if you are interested in the subject you can go and look and find out. He had to make a number of decisions on the pharmacokinetic dynamics on nicotine and nicotine metabolism.

I am struggling to try to remember. The amount was certainly greater than one-tenth of a milligram, but off the top of my head I can't give you a number.

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Q. The amount that was greater than one-tenth of a milligram did those people tend to smoke more cigarettes than they did previously or do you know?

A. I don't know, I don't know.

Q. Now, Dr. Gori, do you know whether any of the research he does is funded by the tobacco industry?

A. Some of the work certainly was because Brown & Williamson paid for it.

Q. So the research that you are referring to on the inhalation pattern of nicotine was paid for by Brown & Williamson?

MR. HOFFMANN: Object to the form of the question.

THE WITNESS: Let me just be sure we are talking about the same thing.

Sometime in the 1980s Dr. Gori did a comparative study of a number of cigarettes that were normally one-tenth of a milligram by the Federal Trade Commission smoking method. Brown & Williamson provided the money to do that study, recruited the smokers. All Brown & Williamson provided were the cigarettes and the standard smoking

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machine numbers. Dr. Gori did his study and published it. Whatever he found out, whatever the answers were is in the public domain in a peer-reviewed journal, but funded and paid for by Brown & Williamson.

Q. (By Mr. Hoag) Is Carlton still sold?

A. Yes.

Q. Does it still put on its label one-tenth of a milligram nicotine per cigarette?

A. I don't know. I never look at the packs.

Q. What about Now, is that still sold?

A. I believe so.

Q. Are those both B&W brands?

A. No. Carlton is now a Brown & Williamson brand. At the time I was working it was owned by American Tobacco Company before they were bought by Brown & Williamson.

Now is a brand of R.J. Reynolds Tobacco Company.

Q. Did you have anything to do with commissioning that particular research Dr. Gori did?

A. I was certainly aware of the study, provided the cigarettes to him. I can't remember if I was the commissioner, as it were, or who it was.

Q. What was the purpose of doing this study?

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A. The purpose of the study was a controversy concerning the relative smoke intake between a number of nominally 1-milligram tar brands. This was done to try and cast some light on the matter.

Q. When you say nominally 1-milligram tar brands, what do you mean?

A. The brand when smoked by the FTC method gave 1 milligram of tar.

Q. What were Dr. Gori's results regarding the 1 milligram of tar?

A. I don't think he -- you can't do that directly. What you can do is make some inference about nicotine intake from looking at codamine levels in the blood, codamine are metabolites of nicotine. It would be like a body marker for tar.

Q. So, for example, the Carlton to your recollection at least at the time this study was done was a one-tenth milligram nicotine, what was it labeled as far as tar content?

A. 1.

Q. 1 milligram?

A. Uh-huh.

Q. So if you find out that the nicotine level is higher than one-tenth of a milligram, what

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does that tell you about the tar level?

A. Well, the tar level would be also higher and it is a reasonable approximation to say it would be roughly proportional. If the nicotine level was five times higher, the tar level would be roughly five times higher. The tar level would be roughly five times higher taken into the mouth but not necessarily absorbed.

Q. I take it you don't know whether or not any of the cigarette companies relabeled those low tar, low nicotine cigarettes after the publication of Dr. Gori's study; is that correct?

A. Well, they didn't relabel the cigarettes, no, because whatever labeling had to be done by the Federal Trade Commission method.

Q. Do you know whether or not the cigarette companies did any campaign to inform the public that the actual nicotine level was different than the nicotine label of the cigarettes?

A. Well, you know, as I said, the cigarette companies funded a number of such studies. This is one example that I am aware of. There is a lot of stuff that has been published in the peer-reviewed literature showing things like this and, you know, the way to inform people is to get things into the

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scientific literature and to healthcare providers of the people that would then go ahead and inform the public.

Q. The 1 milligram of tar, what would that be labeled? Would that be called ultra, ultra low, or ultra light?

A. I think the designation in those days was ultra low. It may very well be still.

Q. If it is 5 milligrams, what is the designation?

A. Still ultra low.

Q. What are the various designations? There is ultra low or ultra light. What are the others?

A. Well, I think that basically -- and I stand to be corrected -- there are three designations. One is the full flavor and is typically, I guess, 13 milligrams of tar and above. Light might be 7 to 12 and ultra low or ultra light might be 6 and below but there are just 3 designations. Ultra low or ultra light, low or light, and full flavor.

Q. The study done by Dr. Gori, you don't recollect the year, or do you?

A. Well, we could easily track it down, like '83, '84, '85, something like that.

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Q. Do you rely on that study for any portion of your expert opinion?

A. Well, it is certainly part of the body of literature on smoker intake. There is probably half a dozen papers in this area by various scientists who all come to sort of roughly similar conclusions.

Q. Hello? Part of his last words kind of left.

A. I said there are a number of papers in this area by scientists external to the industry and they come to roughly similar conclusions whether it is Dr. Russell in England, Dr. Benowitz at the University of San Francisco, Dr. Gori in Washington. There are others whose names escapes me.

Q. You are talking about Neil Benowitz?

A. Yes

Q. Are you familiar with his research?

A. I have read a number of his papers, yes.

Q. What is your impression of the quality of his work?

A. Well, in the work we are talking about where he is trying to ascertain how much nicotine or smoke people are taking in, he and Dr. Gori used very similar methods. I think that most of Dr. Benowitz's work -- again, I may stand to be

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corrected -- has been with patients at smoking clinics whereas Dr. Gori's has tended to sample the public at large.

There might be differences in the people studied but in terms of the methodology, analytical chemistry and the blood work, I think they both used the same methods. I think they have even collaborated and worked together in this area.

Q. Are you familiar with any of the research that indicates the low tar cigarettes do not decrease the level of lung cancer and other diseases in smokers?

A. No, I am not familiar with research that states that.

Q. Do you know whether or not the low tar cigarettes have any positive health effects?

A. Well, there have been suggestions in the literature from time to time by people trying to look at the epidemiology. I can't cite chapter and verse, but there have been from time to time cases -- I am thinking of a fairly recent paper by Hoffman from the American Health Foundation where he is showing how cigarettes differ today from what they were like 30 years ago and he states in the summary that they are less toxic and less

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tumorigenic than they were.

I need to take a break.

(A recess ensued.)

Q. (By Mr. Hoag) When we took the brief break, I think the last thing you were mentioning was Hoffman and his discussion about cigarettes today, his opinion being they are less toxic and less tumorigenic than they were 30 years ago. My question to you is are cigarettes toxic.

A. Well, it depends on the tests that you are doing. If you collect enough smoke and apply it in enough concentration to some animal tissue it can be toxic. Toxicity is in general a question of dose.

Q. Under what circumstances can cigarettes be toxic?

A. Well, let me give you, I guess, an example where if you are trying to investigate the effects of cigarette smoke on the health of mice, if you cause them to breathe too much cigarette smoke, so much carbon monoxide, they could be asphyxiated.

Q. Anything else?

A. Well, the next thing you have to be careful on mice, if you give them too much cigarette smoke, I think they would get a toxic dose of nicotine. So you can certainly kill mice with

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cigarette smoke.

You could kill other animals with cigarette smoke if you gave them enough, or microorganisms.

Q. Is that what Hoffman was talking about when he said cigarettes are less toxic now than they were before?

A. I would have to go back to the original article, get the full context. I am just quoting from my memory of what he says in his summary. That may very well have been, I don't know.

Q. Do you agree with Hoffman?

A. Number one, the sales weighted average amount of smoke coming out of a cigarette by a standard method was reduced almost by a factor of three over a 40-year period, so there is less smoke coming out of a cigarette by the standard testing method, or for that matter any other testing method. He must also be referring to some changes in cigarette smoke composition. Off the top of my head I can't remember what they are but he lays out a table indicating changes in smoke chemistry and the compounds he is looking at are those that have been suggested as possibly having a role in health effects.

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MR. HOAG: I am going to move to strike that answer as nonresponsive. I didn't want to interrupt you, though.

Q. (By Mr. Hoag) My question is do you agree with Dr. Hoffman that cigarettes today are less toxic than they used to be.

A. Well, I think you would have to put that in the context of what the toxicity test is. If you are talking about a toxicity test on some animal and it is, it is. I mean, it is not a question of do I agree or do I not agree. If someone has done a reproducible scientific experiment, it is a fact, it is not one that is debatable, that it is reproducible.

Q. So Dr. Hoffman, has he concluded that cigarettes are in fact toxic?

A. Well, I think Dr. Hoffman felt throughout his career cigarettes are toxic under certain circumstances.

Q. Do you agree with him?

A. Under certain circumstances and tests, you know, applying them to certain test systems I have discussed, they can be toxic. Toxic isn't a word you can use in empty space. You have to define what you mean by toxic, how much and in what system.

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Q. Are cigarettes toxic for human beings?

A. Well, that's a matter of considerable controversy and discussion and has been for the last 40 or 50 years. Epidemiological evidence suggests that for some people they are.

Q. Well, what is your opinion as a scientist, are cigarettes toxic to human beings?

A. For some people, the epidemiology indicates that people that smoke have a greater risk of getting certain disease conditions but what the cause-and-effect relationship is still remains unclear.

Q. Do you agree that if everyone stopped smoking cigarettes there would be fewer people who contract lung cancer?

A. That's what the epidemiology suggests.

Q. I am asking do you agree.

A. I am just trying to think for a moment because we discussed earlier whether there wasn't -- I am sorry, I am thinking of another question you asked me.

I think it likely if nobody smoked cigarettes there would be less cases of lung cancer.

Q. Do you believe as a scientist that it is likely that fewer people would die prematurely if no

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one smoked cigarettes?

A. Can I rephrase that? Let me see if I understand what you are trying to ask me. Do I think if nobody smoked cigarettes, people would live longer. Some people might, some people might not. Mortality is a real complicated area which sort of includes all sorts of lifestyle behaviors, presumably some genetic behaviors, all sorts of things. I am not sure I could really answer that globally or even semiquantitatively.

Q. Do you agree that smoking cigarettes causes at least some people to die prematurely?

A. I think that some people might have lived longer had they not smoked. But you can't tell up front who will and who won't, not even up front but post facto, either.

Q. I know that you are trying to answer that last question but let me try to rephrase it so that maybe we can be on the same -- so we are communicating the same question and answer to each other.

In your opinion as a scientist, is it more likely than not that at least some people who smoke will die prematurely as a result of their smoking cigarettes?

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A. Based on the epidemiology that is published, it is more likely that some of the people who smoke cigarettes will die earlier than they would have done had they not smoked cigarettes.

Q. As a scientist, do you accept the epidemiology as being done in a scientific manner?

A. Well, I think there has been enough epidemiology done and the quality of epidemiologic studies varies enormously; but overall, I mean, the evidence is what it states. I mean, you can argue whether the risk factor is 10 or 15 or 20; but there is a higher risk factor of contracting certain diseases for smokers than nonsmokers. I mean, it is significant.

Q. Have you ever worked at all with the marketing department of Brown & Williamson?

A. Well, in that there has to be an interaction between the product development function and the marketing function in either launching new cigarette brands or modifying cigarette brands, yeah, in that we work together on a joint timetable.

Q. Do you ever meet with any of the marketing people?

A. Yes.

Q. Which marketing people have you had

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occasion to meet with?

A. Well, from the period of, say, 1973 to, again when I retired, almost everybody who was in the marketing department in what is called a brand management function, those were the people that were responsible for the actual marketing of the cigarettes.

Q. What were the names of some of the people that you met with in the marketing department during the time you worked for Brown & Williamson?

A. Well, John Johnston. I am not sure whether he has an E on the end of his name or not. Dick Johnston. Scott Wallace. Dick Blott. Patrick Tighe. Bill Shrimhorn. Bonnie McCafferty. And a host of others.

Q. When you met with these people, did you meet with them individually or was it in groups?

A. Well, both.

Q. What product or products did you have occasion to discuss with any of the people in the marketing department?

A. Well, virtually all the products that Brown & Williamson sold. Viceroy King size, Viceroy 100s, Viceroy Lights King size, Viceroy, through the Raleigh family of cigarettes, Kool family of

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cigarettes, Capri, Barclay, Belaire, anything we sold.

Q. Let's take Kools, for example. What kind of, what is some of the contact you had with the marketing department related to Kools?

A. Well, if we go back sometime into the '70s, Brown & Williamson sold just three kinds of Kools. There was a Kool nonfilter, there was a Kool King size filter and the Kool 100s filter. Around this time people started marketing lower tar versions of their major brands of cigarettes. So I worked with the marketing department on the development of the cigarette that was then marketed as Kool Mild. Later on we worked on the development of a cigarette called Kool Super Lights and Kool Lights, those kinds of things.

Q. What was Kool Mild, what did it have in it other than tobacco?

A. Menthol. I mean, the major difference, if you like, between Kool Mild and what we call the parent Kool was that Kool Mild had a longer filter so that it removed more of the smoke and so there was less tobacco available to burn, so that the Kool Mild when it was first launched may have had 12 milligrams of tar whereas the parent Kool may have

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had 17 or 18 milligrams of tar.

Q. And that is measured by the machine smoking method, correct?

A. Correct.

Q. How much nicotine did the Kool Mild have?

A. Well, I don't remember as a matter of record; but if it would have had 50 percent less tar it probably had about 50 percent less nicotine in the smoke.

Q. What would that come down to, 1 milligram?

A. Yeah. If it was 1-1/2 it would come down, I think it probably had about 1.

Q. What is the purpose of putting menthol in a cigarette?

A. Well, apparently -- and this was something that happened, I guess, in the '30s -- somebody tried it somewhere and some people liked the taste of it. Some people like mentholated cigarette smoke and some people don't for reasons we never understood.

Q. Did menthol reduce the irritation in any way?

A. I don't think so. It might a little bit.

Q. Well, what effect, if any, does menthol

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have on the taste of the cigarette?

A. Well, it is a sort of a cooling sensation. And I am assuming you are a nonsmoker. Have you ever smoked a regular cigarette and a menthol cigarette?

Q. Usually I wouldn't answer a question, but no, I have never smoked.

A. Well, you have probably sucked candy. If you suck a minty candy it has a cooling sensation in your throat and that, I mean, it is very similar. So it is like comparing a regular candy with a mint candy or a vanilla cream chocolate with a chocolate mint. Menthol cigarettes have a kind of minty flavor.

Q. Now, for example, when you would be meeting with marketing people to discuss Kool Milds, what was your contribution to these discussions?

A. Well, there are really two parts. One is the timing, we would like to launch this Kool Mild cigarette next May; and we would say, well, perhaps, you know, we could do it in July. They say, we really need it in May. We come up and say, let's do it in June.

So there was a timing issue. But then the other part is determining the specifications and

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basically these came down to the length of the cigarette, tne length of the filter and the tar delivery and then how you were going to determine success, if you like, in the testing of the cigarette because before we would launch a cigarette generally we would test it with smokers in blind taste tests to see if they liked it. So I am working out the details for that.

Q. Did smokers in general in these blind taste tests, did smokers in general like the cigarettes that had one-tenth of a milligram of nicotine?

A. Well, you have to define your smoker group.

If you are testing those cigarettes like that you test it with smokers who smoke and are interested in ultra low tar cigarettes. If you gave it to someone that smoked unfiltered Camel cigarette they probably wouldn't like it. If you gave it to someone who smoked an ultra low tar cigarette, they might very well like it. You have to test cigarettes with the consumers that are interested in that particular type of product.

Q. If you took a hundred thousand smokers, just an average group of a hundred thousand smokers,

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approximately how many of those smokers would be interested in the one-tenth of a milligram nicotine cigarette?

A. I think the easiest way to answer that question is to say if you took what the market shares of the various arrays of cigarettes are that are sold on the U.S. market today -- and I haven't looked at such figures for a long time -- if you bear with me, it is probably of the order of 3 percent of the cigarettes sold might be 1 milligram of tar or less. It is that sort of order. Then you would probably find that 3 percent of a hundred thousand, so 3,000 people would like them.

Q. Did the marketing people ever show you any of their marketing campaigns prior to implementing them?

A. Yes.

Q. And what was your contribution or discussion related to those marketing campaigns?

A. If there was any technical claim to verify that this is true. Now, always we would verify if the advertising said, for example, 10 milligrams of tar and 1 milligram of nicotine by FTC method, then R&D would have ensured that that indeed was the numbers that was given by that cigarette.

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It was very rare that any other technical claim was made. But if it was, again, it would be verification of that. They weren't looking for our input of the aesthetics or appeal of the marketing, just any technical veracity.

Q. When did you first start meeting with the marketing people to discuss issues related to the marketing of cigarettes?

A. Oh, I would say fairly early on in my career, certainly by 1970, '71.

Q. Did the marketing people ever discuss with you who, which smokers the given campaign was intended to influence?

A. Well, in sort of real general terms, yeah.

Q. What segment of the population was the Kool brand intended to influence or be marketed to may be a better word?

A. Well, the Kool brand was for people who liked menthol cigarettes and the competitors for Kool were Salem and Newport. So when we were developing a new, improved Kool or a lower tar version of Kool, we wanted to make sure not only Kool smokers liked it but Salem or Newport smokers would like it better than Salem or Newport

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cigarettes.

Q. Do you know whether or not the Kool brand was marketed toward a younger demographic than some of the other brands?

A. No. You find out the demographics of what your smokers are by just a survey and finding out how old they are. I think in general Kool smokers tended to be older than Newport smokers and Kool smokers were roughly the same age group as Salem smokers.

Q. What age group are you talking about?

A. Average age, gee, probably about 35 or 40.

Q. Any particular ethnic group for the Kool cigarettes as compared to other cigarettes? You know, people thought that Kool appealed particularly -

A. Well, I think people thought perhaps that African-Americans smoked more relatively high percentage of menthol cigarettes than other groups; but I think, you know, in total there were more white smokers of Kool than there were black smokers of Kool simply because it is like, whatever, five times as many white people in this country as black people.

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Q. Were any of the brands, the B&W brands, specifically targeted to a younger segment of the population?

A. Well, I think by agreement with whatever the -- I am not sure if it was the Federal Trade Commission or just an advertising code within the industry, models had to either look or be older than 25, something like that. We did not do any testing of our cigarettes with anyone under the age of 21. As far as I know, correct me if I am wrong, legal age of smoking in most states then, I am not sure what it is now, but then was 18. But as I say, we didn't test with anyone under the age of 21.

Q. And the models had to look or be over what --

A. 25. You know, I shouldn't speculate, I was trying to be responsive but this is a matter of record, again, that could be found out. So anyway, my basic answer is no, what we tried to do was to get people who smoked other brands of cigarettes, whether it is Salem or Newport or Marlboro, Winston, to choose our cigarettes. What the marketing promotion about is trying to get people to switch from a competitor's brand to your brand.

Q. The advertising campaigns that you would

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look at, what kind of ads would they use to encourage people to smoke, for example, the Kools?

A. Well, remember what I said is we are trying to persuade Salem smokers to smoke Kool rather than Salem. You are really asking me questions out of my area of expertise so I don't think I can answer that in any sensible fashion.

Q. Would the marketing people actually show you some actual mock-ups of ads they intended to use?

A. They might out of courtesy, but they didn't have to.

Q. Did you ever make any comments about any of the advertisements they showed you?

A. I probably did, but I can't remember any specifics.

Q. Going back to your prior discussion of the research of Dr. Hoffman are cigarettes in your scientific opinion tumorigenic?

A. In certain tests you can cause cigarette smoke to produce skin tumors on mice or rabbit ears, for example.

Q. On mice or what?

A. Rabbit ears. Mouse skin or rabbit ears. I think they had to be particularly susceptible

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strains of mice and rabbits, too.

Q. Cigarettes are still tumorigenic, correct?

A. To the skins of mice, certain strains of mice, yes. The cigarette smoke can be if applied for long enough.

Q. That's still true today just like it was 30 years ago; is that right?

A. I don't know that anyone does that test today. My scientific opinion would be if you did it it would be.

Q. Are cigarettes and/or cigarette smoke biologically active?

A. Again, if you can apply enough of the smoke to the correct organism, yeah.

Q. What are the carcinogenic components in cigarette smoke?

A. Well, you have to define carcinogen in terms of the dose and the mode of application and the organ but compounds in cigarette smoke that is applied in sufficient quantity to animals that are known animal carcinogens include 3,4-benzopyrene, dimethyl nitrosamine. Another nitrosamine that has a very long name, NNK, it is easier to call it NNK. There are some other polynuclear aromatic

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hydrocarbons whose precise chemical names escape me. So there are about 11 compounds in total, I think, that have been identified as animal carcinogens. It is obviously difficult to determine which ones of these are human carcinogens in sufficient dose, though I think it is accepted that 3,4 benzopyrene is. I am just not sure about the nitrosamines.

Q. Is it possible to remove the benzopyrene from the cigarettes and tobacco smoke?

A. Well, I don't think there is any benzopyrene per se in tobacco or if there is it is a very minute amount. It gets generated during combustion of tobacco. A lot of work has been done trying to change the concentration of that in cigarette smoke with no real success. So a reduction in benzopyrene emanating from the end of a cigarette would come by a reduction in the amount of tar.

Q. You said there has been no real success in reducing the benzopyrene level --

A. The concentration with respect to the amount of tar, by lowering the amount of tar, you lower the amount of benzopyrene. We may need to take the Hoffman paper, I don't know if there is a

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slight change in concentration of benzopyrene.

Q. When you say by lowering the amount of tar, if you had -- are you saying, then, if you had 1 milligram of tar instead of 10 milligrams of tar then you would reduce the benzopyrene level by a factor of 10?

A. Yeah.

Q. Does cigarette smoking cause any disease?

A. Well, you know, we have said that the epidemiological evidence says that there is an increased risk of a number of diseases for people who smoke, not everybody who smokes. The large majority of smokers don't get these diseases but more smokers get these diseases than nonsmokers.

Q. I know you answered a question, but it really wasn't the one I asked. Mine is about cause. In your scientific opinion, does cigarette smoking cause any disease?

A. Well, there is no classical cause-and-effect demonstration of cigarette smoking causing disease in human beings.

Q. So is it your scientific opinion that cigarette smoking does not cause any disease?

A. No. My scientific opinion is that there is an increased likelihood of getting disease for

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some smokers. Now, I can't tell you up front or even afterwards which smokers may or may not get a disease from smoking of cigarettes; but there is a likelihood for a person who smokes, there is a greater likelihood they would get a disease than a nonsmoker.

Q. Is it your scientific opinion that cigarette smoking causes disease for some smokers?

A. It is likely that it does for some smokers. That's what the epidemiology shows.

Q. And your scientific opinion agrees with the epidemiology, is that correct?

A. Well, I don't see how my scientific opinion can disagree with the epidemiology. I mean, epidemiology has produced a big database with these findings.

Q. What is your estimation of the number of people that die as a result of smoking cigarettes each year?

A. I have not attempted to develop my own personal estimation, but I do think the number that is often bandied around of the order of 450,000 is probably inflated.

Q. You think it is only a hundred thousand?

A. No. I said 450,000 is the number that is

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generally bandied around.

Q. You said that's inflated.

A. That's just my personal opinion that is inflated.

Q. How much do you think it is inflated by?

A. I told you I didn't know. I said I have not attempted to come up with a Lance Reynolds' answer.

Q. Do you think it is at least a hundred thousand people per year?

A. Yes, probably.

Q. How about 200,000?

A. You're talking about all the smoking associated, the diseases that allege to be caused by smoking.

Q. I am talking about the number of people in the United States who smoke who die each year as a result of smoking cigarettes.

A. Okay. Based on the epidemiology, there is some factor which I would accept as likely to be greater than a hundred thousand, I think it is less than 400,000. I have got no idea of what that number is.

Q. Have you ever said that before, probably, that in your estimation it is at least a hundred

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thousand but less than 400,000?

MR. HOFFMANN: I am going to object to the form because, I mean, he qualified his answer by saying based on the epidemiology. I think it is clear what his answer was, is that the number as given by the epidemiology is inflated and even if one accepts the epidemiology the number is significantly less. I don't think unqualified it is his opinion.

MR. HOAG: I object to your lengthy speaking objection, it appears to be some effort to cue the witness as to how you want him to respond to my question.

I am merely asking has he ever stated what he just said to me in that last answer, has he ever stated that publicly before.

Q. (By Mr. Hoag) Can you answer that question, please.

A. Let's make sure we are talking about the same answer. I said that based on the epidemiology I accepted that it was probably more than a hundred thousand, I thought it was less than the 400,000. I have got no basis for knowing what the number is.

In answer to your question, have I ever

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stated that publicly before, I don't think anyone has ever asked me that before.

Q. You have seen on the warning on the cigarette package that says surgeon general's warning, cigarette smoking causes lung cancer, heart disease and emphysema. Do you agree with that, that that is an accurate reflection of reality, that cigarette smoking causes lung cancer, heart disease and emphysema?

A. I think I had this discussion with you in the last deposition. The epidemiology shows an increased risk of lung cancer, heart disease and emphysema associated with the smoking. It is the Surgeon General's job to advise people what he or she considers are health risks and what behaviors may adversely affect their health and so that's what the Surgeon General's job is to do and the companies have agreed to put that on the packages. It obviously doesn't for the vast majority of smokers, it may do for some.

Q. Those marketing advertisements that you looked at, did they usually depict people in pleasant surroundings having a good time?

A. I am trying to think of specifics. A lot of them were just kind of for menthol cigarettes, at

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one time were scenery, mountain streams, cooling refreshments.

Viceroy I can't remember because it wasn't advertised very much for a long time. It used to be a thinking man's cigarette, whether you think a thinking man has a pleasant surrounding, I don't know. I guess that is kind of subjective.

I can't remember any specifics of Raleigh or Belaire advertising.

You know, cigarette advertising in general is not something that really sticks in my mind.

Q. Mountain streams, you recollect that, though?

A. Yeah.

Q. Were these mountain streams without people, just the mountain stream itself?

A. I think so, but don't pin me down on that.

Q. The mountain stream, was it daytime, was it sun shining?

A. I don't remember.

Q. Did it depict anyone smoking a cigarette by the mountain stream or do you remember?

A. I think my recollection is there was some

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advertisement without people and there may have been some with people. I don't know. I really can't remember.

Q. So the point of the advertisement for the person who viewed the advertisement was meant to equate the cigarette with a mountain retreat; is that correct?

A. Well, the menthol cigarettes provide a cooling sensation, mountain streams are generally cold. Yeah, I think that would be a fair enough.

Q. Did the menthol have any quality that protects individuals from disease who may inhale the cigarette smoke?

A. Not that I know of.

Q. Do you have any friends or relatives who contracted tobacco-related diseases?

A. Well, no one, no immediate friends or relatives who have died as far as I know from tobacco-related disease, no.

Q. I know I am going to repeat a few things from the Broin case but these are separate cases, so it is necessary to make a record in separate depositions.

Are you a smoker?

A. No.

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Q. Have you ever smoked cigarettes?
A. Yes.
Q. And how long did you smoke cigarettes?
A. About 37 years.
Q. When did you stop smoking?
A. About two years ago.
Q. How many cigarettes per day did you smoke during the time you did smoke?
A. Well, it depended on the time in my life. On average it was probably around a pack or more.
Q. How old were you when you first started to smoke?
A. Well, off and on, 17, probably smoked the occasional cigarette even when I was, I don't know, 12, 13.
Q. The first time you actually smoked a cigarette was when you were 12 or so; is that right?
A. I think so, yeah. I mean, I am not sure I smoked the whole cigarette, may have a friend at school offering me a puff or two.
Q. What year was that?
A. Well, I am trying to recollect but I said it was around when I was 12 or 13, so '51, '52, something like that.

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Q. Did you like that first cigarette?
A. You know, I can't remember.
Q. The reason I ask, some people first time, their recollection of the first time they smoked made them sick. Do you recollect anything like that?
A. You know, we had this discussion before. There may have been times when I did have a cigarette that did make me feel sick and other times it didn't. It is hard when you are 58 to go back to when you are 12 or 15 or 16.
Q. This was in Great Britain at the time when you were 12 or 13.
A. Yeah.
Q. What were the advertisements for cigarettes back then?
A. I don't know. I don't remember as a 12- or 13-year-old looking at cigarette advertising.
Q. Did they have cigarette advertising back then?
A. I guess so.
Q. Back in '51, '52, they had television in Great Britain, right? I am not being sarcastic because I remember the first time I watched TV was around then myself. They did have a television

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in '51, '52?

A. I came from a relatively poor household. I don't think we ever had a television in the house when I was going up. I went to a boarding school where we didn't have television, either. So I didn't have television in my home until I was about 21 or 22.

Q. Do you recall any advertisement for cigarettes in the 1950s that implied or stated directly some positive health effects from a certain brand of cigarettes?

A. Well, I don't -- I have been struggling to think as we talked, I can't recollect any English cigarette advertisements from that period in time.

Q. You started to smoke when you were 12 or 13, started to smoke maybe a couple of cigarettes. When did you become a regular smoker?

A. After I left high school.

Q. Which was what age?

A. Almost 19.

Q. And from the time you were 19 until you stopped smoking two years ago, did you pretty consistently smoke about one pack a day, one pack or more a day?

A. The majority of the time, yes. When I

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was very young, no; when I was older, no; but the majority of the time, yes.

Q. Did you ever some time before you actually quit cut back on the amount of cigarettes you smoked?

A. Sorry. We are getting an interruption from the telephone.

(Outside interruption.)

Q. (By Mr. Hoag) Prior to the time you quit two years ago, during that 37 years that you smoked, did you ever cut back on the number of cigarettes you smoked?

A. Yes.

Q. And when did you do that and how did you do that?

A. Well, first time I did it was probably when I was out of money and had to wait until my next paycheck which would probably have been; I don't know, when I was 22, 23, something like that. When I retired from Brown & Williamson, I cut back, I just smoked about half as much each year as the preceding one.

Q. Was there ever a time you totally quit prior to the time you quit two years ago?

A. Depends on the matter of definition. I

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said earlier I think there was one occasion I ran out of money and had to wait three or four days until I got paid again. I didn't quit for like six weeks or six months and restart, no.

Q. You stopped smoking for three or four days at some point because you couldn't afford to buy cigarettes.

A. That's correct.

Q. As soon as you got money, you went back and bought some cigarettes, right?

A. That's right.

Q. You weren't making very much money at the time, right?

A. Right.

Q. Why did you three or four days later as soon as you got money decide to keep smoking cigarettes?

A. Because I liked it.

Q. I think you said you gradually decreased the amount you were smoking until it was half as much as it was when you were up to a pack a day; is that right?

A. When I retired?

Q. Uh-huh.

A. What I said was when I retired I cut back

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every year, just kind of dwindled away, faded away over a four- or five-year period.

Q. So in other words I think, then, what you are saying is in year one you maybe went from one pack to a half a pack, is that what you are saying?

A. Yeah.

Q. A day?

A. Yeah.

Q. Then year two you went from ten cigarettes to maybe five cigarettes, is that what you mean?

A. Right.

Q. Then year three, maybe five to three and then like that, is that what you mean?

A. I went from five to three, yeah, then I just totally gave it up.

Q. So at the point you were smoking maybe three cigarettes a day, that is when you decided to quit and not smoke any cigarettes a day; is that right?

A. That's right.

Q. And the length of time it took you to go from one pack a day to all the way down to no cigarettes a day was about four or five years, correct?

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A. That's the period of time over which this change in smoking consumption occurred.

Q. What was the reason for the change in smoking consumption?

A. Well, once I retired -- I think we have had this discussion before -- I elected not to smoke in the house. While it was fine when I was living in Florida, it wasn't much fun in Washington State in the winter.

Q. So it was uncomfortable to smoke in the cold?

A. Yes.

Q. For a while there you would still go out and smoke in the cold sometimes; is that right?

A. Yes.

Q. For what period of time did you still go out and smoke in the cold before you totally stopped going out there and smoking outside?

A. Well, I guess a couple of winters.

Q. So there was something about that cigarette you liked so much that you were willing to sit outside in the cold winter and smoke for a couple of winters, correct?

A. You could look at it that way. What happened, I said, this is real silly, I am not

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enjoying this at all, so I stopped.

Q. At some point that cold weather overrode whatever pleasure you were getting out of the smoking of a few cigarettes out on the porch; is that right?

A. I got no trouble with you describing it like that if that is your desire.

Q. Well, is that right? If it is not right, you can put it any way you want.

A. This seems to me such a ponderous discussion. It is up to you, it is your time.

Q. Thanks.

A. I just repeat what I said. I said, this is silly, what am I doing standing out here freezing my butt off smoking a cigarette, I am not going to do it anymore.

Q. Nicotine obviously is one of the components in cigarette smoke, correct?

A. Nicotine is one of the components in cigarette smoke, yes.

Q. Is it possible to remove the nicotine from cigarette smoke?

A. It is possible to remove most of the nicotine from tobacco. Philip Morris did this and marketed a cigarette brand called Next which

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delivered virtually no nicotine.

Q. But no one really wanted to buy that cigarette, right?

A. Right.

Q. Did it taste good, cigarette without nicotine?

A. I think I tried one of them. It didn't taste bad. I think Philip Morris wouldn't market a cigarette that tastes bad. You know, I can't comment.

Q. Isn't it true no matter how good a cigarette may taste, if it doesn't have nicotine in it, people are not going to smoke it?

A. That would appear to be the experience of cigarette manufacturers, yeah.

Q. Is that because nicotine is a drug, correct?

A. Well, if you define a drug as something that does have some interactions with organisms, yeah, sure.

Q. Well, it has an effect on the brain, correct?

A. Yeah.

Q. Nicotine affects the dopamine level, correct?

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A. Well, there is a lot of changes in neurotransmitter concentrations when people smoke cigarettes, and I believe dopamine levels are changed; but this isn't an area of great expertise for me.

Q. Not only does the nicotine stimulate the release of dopamines it also takes the action of MOA, correct?

A. I don't know.

Q. You know what I mean when I say MOA?

A. I think you mean MAO.

Q. Monoamine oxidase?

A. There has been a huge amount of work done and published and reported in the scientific literature trying to examine the effect of nicotine on neurochemistry, brain chemistry, it is not an area of expertise for me. There are effects, but I don't know what they are.

Q. Does ammonia increase the absorption rate of nicotine?

A. No.

Q. Did you say no?

A. I said no.

Q. What do you base that on?

A. Well, it doesn't.

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Q. I understand you just said it doesn't. I am asking you what is your scientific basis for that, that conclusion.

A. Well, the absorption of nicotine -- I am going to have to give you a fairly lengthy answer here but the cigarette smoker, the absorption of nicotine, if they fully inhale a puff of smoke is 90 percent or greater and apparently it happens almost instantaneously whether they are smoking an English cigarette which is relatively acidic or an American cigarette which is closer to a neutral pH and I very much doubt if there is -- I mean, the nicotine absorption happens in the lung pretty fast. It gets in the bloodstream and goes to the brain within about ten seconds as I understand it and, you know, I am not aware that there would be any difference between an English cigarette in this phenomenon and an American cigarette. There, as I say, you have this difference in smoke pH and so, no, it doesn't.

Q. Have you read an article that was printed in this year, the summer of this year, titled Conversion of Nicotine and Tobacco Smoke to Its Volatile and Available Free Base Form through the Action of Gaseous Ammonia?

A. Was this by Pankow?

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Q. Yes.
A. Yes, I have.
Q. You read that article. Do you agree with the conclusions in that article?
A. No.
Q. And what about that article do you disagree with?
A. I don't have it in front of me. It was about two months ago when I looked at it -- and there are -- there is really -- it is a strange article because there are some factual science and some analytical measurements which Pankow does which is fine and he is good at doing, then there is some speculation and conclusions drawn which don't really have any relevance to the data therein. I can't give you a more complete answer than that right now because, as I say, I don't have it in front of me.
Q. You have a fax machine there, right?
MR. HOFFMANN: I mean, yeah.
MR. HOAG: What is the fax number? I have the article, I would like him to look at it.
MR. HOFFMANN: Let me see, do we have a copy in our files that would show that? Does anyone know?

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THE WITNESS: There is two Pankow articles as well.

MR. HOAG: It is an exhibit in Engle, Exhibit 1844. If you have it, I don't need to fax it to you.

MR. HOFFMANN: We might be able to pull it faster than you can. Let's take a five-minute break while we are doing that.

(Discussion ensued off the record.)

(A luncheon recess ensued.)

Q. (By Mr. Hoag) Back on the record after a lunch break.

Have you had a chance to locate the article we were talking about, the conversion of nicotine in tobacco smoke?

A. I have a copy of that article with Exhibit No. 1844 on it. The copy I have does not have the figures.

Q. Doesn't have what?

A. Does not have the figures. It says see figure 1, see figure 2, see figure 3. I don't have the figures.

Q. That figures. Let me, I think I have those. You have all the way up to Page 9 which has the citations?

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A. Well, I have actually Page 10 and Page 11 which have some tables. I have Table 1, Table 2 and Table -- I am not sure if it is Table 3. I have 3, yeah, I have Table 3; but I don't have figure 1, figure 2 or figure 3.

Q. I am not sure what those are referring to unless it is Table 1, Table 2 and Table 3. I think this is the entire article, I think.

A. Well, with all due respect, I think figures 1, 2 and 3 are missing.

MS. BROWDY: This is Michelle Browdy. There are no pictures in your version that is labeled an Engle Plaintiff's Exhibit 1844. There are tables, there is no graphs or pictures or diagrams.

MR. HOAG: Do you have that, the one with tables, diagrams, pictures?

THE WITNESS: No, we don't. We have some tables, but we don't have diagrams or pictures.

MR. HOAG: I am asking the attorneys if they have a copy of the ones with the tables and diagrams.

MR. HOFFMANN: The only thing we have been able to find is Plaintiff's Exhibit 1844

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in the Engle case which you provided, that is what we are looking at, that goes up through Page 11 and the last thing on it is a chart with some numbers on it which is labeled as a table. I am sorry, Table 3 is the last thing we have on it.

Q. (By Mr. Hoag) So you recollect when you read the article that you saw figures separate and apart from the tables; is that correct?

A. Well, no. I am basing more my comment on the fact if we go to Page 6, for example, top of Page 6, there is a thing that says figure 2, Log of K_p versus ammonia pressure for environmental tobacco smoke and mainstream tobacco smoke from two different brands of commercial cigarettes. I don't have that figure 2. Likewise I don't have figure 3 or figure 1.

Q. Have you read this article before today?

A. Yes.

Q. And do you recall whether when you read it you actually looked at the figures, figure 1, figure 2, figure 3?

A. Well, I don't have a recollection but I assume I did, yeah.

MR. HOAG: Before I get to that, which

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I do want to have it marked as Plaintiff's Exhibit 1 for purposes of this deposition, might as well do that now.

(Plaintiff's Exhibit 1 was marked for identification.)

Q. (By Mr. Hoag) Now, before I get to Plaintiff's Exhibit 1, going back a little bit to your prior testimony today, with reference to your opinion it is more likely than not a hundred thousand people per year die as a result of smoking cigarettes, you said that you didn't think the number was as high as 400,000, correct?

MR. HOFFMANN: Object to the form of the question.

Q. (By Mr. Hoag) Is that correct?

A. Based on the epidemiology of the epidemiological findings, if you accept the epidemiological findings, the epidemiology is suggesting these hundred thousand people would -- let me restate that. The epidemiology is stating that there are people who die who would not have died if they had not smoked, that is an epidemiological finding.

Q. You said if you accept the epidemiological findings, do you accept the

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epidemiological findings?

A. An epidemiological finding is an epidemiological finding, if it is done enough times with enough people -- I mean, the results of the epidemiology say excess deaths are attributed to cigarette smoking, that's not showing cause and effect, that's the epidemiological finding, that people who smoke, more people who smoke get these diseases than people who don't smoke. As we were talking about this morning, there were these risk factors of like ten times, so it is written down what I said. What I recollect I said and this is going to be repeating myself now is that if you accept the epidemiological findings, then some excess number of people's deaths may be attributable to smoking; but I am not, as you well know, an epidemiologist.

You have got lots of other people that can go in the data and argue back and forth about the numbers. I am repeating myself. If you accept the epidemiology, some number of people's deaths are attributable to cigarette smoking.

Q. What do you base the hundred thousand figure on?

A. You know, I don't really know. I just

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innately think it is not this large number of people that is bandied around, this 450,000 excess deaths a year are being attributed to smoking. I am not an epidemiologist and it is not very profitable for you to ask me to speculate on this because there are plenty of experts on both sides that could discuss it for you rather than me.

Q. Yeah. I just wanted to clarify why your opinion was that you agreed with a hundred thousand based on the epidemiological studies but you don't agree with 400,000, that was my question.

MR. HOFFMANN: Object to the form of the question.

THE WITNESS: I think your question to me was why did I agree on a hundred and disagree on 400,000.

Q. (By Ms. Hoag) Yes.

A. I am not sure I agreed on any of these numbers at all. All I said was that the -- I am repeating myself, you know, the epidemiological findings are that there are some deaths related to -- let me start again. The risk factor for people who smoke is getting a particular disease is greater than for nonsmokers. Now, how all these translate out into actual numbers of deaths is

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really beyond my competence to calculate or speculate on.

Q. Did you discuss this during the break at any time with anyone?

A. Yes.

Q. And what did you say and what were you told?

A. They said, what is your area of expertise.

I said chemistry.

They said, talk about what you know about and don't speculate about what you don't know about.

Q. They told you that answer you gave, they didn't like it very much then, the hundred thousand answer.

A. They asked me what I based it on much as you asked me what I based it on and I had no satisfactory explanation for that.

Q. They pretty much told you to back away from that answer you previously gave, then, huh?

A. No. They asked me what I based it on. I thought about it and I have told you.

Q. So that hundred thousand figure, you kind of pulled that out of the air, you don't have any basis for it at all; is that right?

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A. I think that's probably accurate, yeah.

Q. That's pretty much what you discussed during the break, correct, with the attorney?

MR. HOFFMANN: Object to the form.

Q. (By Mr. Hoag) That is correct?

A. They asked me, as I have just said, what I based it on. I said, I really don't know. I just kind of said it.

Q. Well, you obviously read the literature, correct, the literature, the epidemiological studies, you reviewed some of those, correct?

A. I have seen them.

(Outside interruption.)

Q. (By Mr. Hoag) So you have read some of the epidemiological studies on the health effects of cigarette smoking, correct?

A. Correct.

Q. Those epidemiological studies were done in a scientific manner, correct?

MR. HOFFMANN: Object to the form.

THE WITNESS: Well, I think we would have to take, you know, various studies and some of them are much larger. There has been a huge number of studies done over the years.

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As I said this morning, I know we spoke specifically about lung cancer for a moment, that the risk factor depending on the study, depending on the country is somewhere between ten times and 20 times than a nonsmoker and I think they also mentioned at the same time that is not showing cause and effect because nine out of ten people who smoke don't get lung cancer anyway.

Q. (By Mr. Hoag) Nine out of ten people who get lung cancer are smokers, correct?

A. It is that sort of order, too, yes.

Q. So based on those epidemiological studies you are of the opinion that it is more likely than not that cigarette smoking kills some people each year, correct?

MR. HOFFMANN: Object to the form of the question.

Q. (By Mr. Hoag) Is that correct?

A. You know, this is getting very repetitive.

Q. Go ahead. You can answer.

A. We both agree in broad terms on what the epidemiology demonstrates, that someone who smokes -- smokers are nine times as likely as

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nonsmokers to get lung cancer. That is my understanding of the epidemiology, is that roughly yours?

I assume your silence means yes. What else is there to say.

Q. Well, whatever your response is is, I guess, what there is to say. I just wanted to ask you the questions, though, rather than me answer questions about my opinions because it is not going to be admissible anyway, what my opinions are.

So have you read the epidemiological studies related to heart disease and smoking?

A. You know, I can't recall any of those specifically, no.

Q. Now, just to clarify, you aren't taking back anything you already said previously in this deposition, are you?

MR. HOFFMANN: Object to the form of the question.

THE WITNESS: Well, you know, my understanding is that I will have a chance to review the deposition for the accuracy of what has been transcribed and what I have said is what I have said.

Q. (By Mr. Hoag) You are not going to

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change it based on anything the attorneys told you at break, are you?

A. Well, I don't even know how I can answer that question. We have covered a lot of ground this morning. Everyone has come to a specific area.

Q. Well, the opinions you are giving are your opinions and not the opinions of the attorneys, correct?

A. Yes, correct.

Q. So you are not going to change anything based on what some attorney told you at break this afternoon, correct?

A. Well, look, what I have said is what I have said is a matter of record and this discussion is continuing. What I am saying is what my understanding of your various questions is which I am answering to the best of my ability. Beyond that, I don't see how I can answer you.

Q. Did the attorneys make any other comments about your testimony today other than what you already told me?

A. My silence is because I am trying to think.

Nothing that I can specifically recollect.

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Q. Did you answer?

A. Yeah.

Q. I didn't hear your answer.

A. I said I have been thinking and I can't recollect anything.

Q. Referring now to what has been marked as Plaintiff's Exhibit 1 for purposes of this deposition which is also Plaintiff's Exhibit No. 1844 in the Engle case, do you recognize that?

A. Yes.

Q. What is it?

A. It is an article published in Environmental Science and Technology, by James Pankow and some other authors, accepted for publication in June of 1997.

Q. Are you familiar with the journal?

A. I have seen occasional issues of it. I have never read it on a regular basis, no.

Q. Is it a peer-review journal?

A. My understanding is that it is; but I don't know, you know, I don't know for sure.

Q. Do you know any of these authors that are listed in the article?

A. I have heard the name Pankow before, but I have not met any of these authors and I have not

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heard of any of the other names.

Q. How did you come to hear the name Pankow before?

A. I believe he has done work on the partitioning of chemicals between particulates and vapor phase.

Q. Had you read some of his work?

A. I don't think so, no.

Q. Other than this article, you haven't read any other work of Dr. Pankow's, correct?

A. Well, he had one published about a year before this on ETS. I don't remember whether I read it or not.

Q. Referring to the first sentence of the abstract, it says, Ammonia-forming compounds are routinely added to cigarette tobacco. Is that true?

A. It is rather an overgeneralization. Some ammonia forming compounds are added by some manufacturers to some cigarette brands or used in the manufacture of reconstituted tobacco. So it is a bit of an overgeneralization.

Q. Which Brown & Williamson brands do not add ammonia-forming compounds?

A. Well, it has changed over the years. When I was there it was not added in any to the Kool

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or Belaire brands or in fact any of the GPC brands. I believe the GPC brands now contain ammonia-reconstituted tobacco and I don't recollect off the top of my head which, if any, Kool brands contain ammonia-reconstituted tobaccos.

Q. All the other brands to your knowledge have the ammonia-forming compounds added?

A. To my knowledge, I mean, it is a matter of record. I would say that certainly the majority of nonmenthol brands do.

Q. The menthol brands are less likely to have the ammonia-forming compounds added; is that right?

A. Certainly when I was working there, yes, that's correct.

Q. And to the extent that that has changed, you wouldn't be aware of it; is that correct?

A. I think it is in some, but I am not sure of the specifics, that's correct.

Q. Now, would you agree that ammonia-forming compounds promote the formation of the volatile free-base form of nicotine in mainstream smoke particles?

A. No.

Q. And why do you not agree with that?

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A. Well, because there is not enough of it to do that.

Q. How much would you need to do that?

A. Well, I am not sure but I think a bucketful as opposed to what is here. I really don't know. My answer comes from reasoning based on the behavior of British cigarettes which are relatively acidic compared with U.S. cigarettes which are closer to a neutral pH and there is almost total nicotine absorption from both.

I guess it is pretty complicated. We are talking about a lot of stuff here. But the nicotine absorption in the human as best of my current understanding doesn't really depend on the nicotine being in vapor phase form. It appears to be absorbed anyway, no matter what the smoke pH is once the smoke is inhaled.

Q. When you said a bucketful, did you actually mean a bucketful or did you mean something less than a bucketful?

A. I think if you had a bucketful the cigarette would go out. I meant a considerable amount.

Q. So if there was more added, then it might have that effect; is that right?

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A. Well, what I am saying -- well, I think we need to be clear what we are talking about. If we are talking about the absorption of nicotine by smokers when they inhale cigarette smoke, is that what we are talking about?

Q. Well, this question was specifically on whether or not ammonia-forming compounds promote the formation of volatile free-base form of nicotine in mainstream smoke particles.

A. No. There is not enough there to do that.

Q. So that means if you had more, it would do that; is that correct?

A. Well, I am not sure if it is practical to get enough more.

Q. Well, have you done any research to figure that out?

A. No. Why would I want to.

Q. Have you done any research to find out if the amount of ammonia-forming compounds that are in cigarettes now actually have that effect of formation of volatile free-base form of nicotine in mainstream smoke particles?

A. I told you before what happens when cigarettes are smoked. It is clear that that is

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the -- that doesn't happen.

Q. Have you done research to verify that does not happen?

A. Well, I mean, the facts are it doesn't happen. The sun rises in the east, I don't have to do research to show the sun doesn't rise in the west.

Q. Well, didn't these authors led by Pankow reach the conclusion that in fact it does do that?

A. Well, that is what their article states, I mean; but what I am telling you is that in cigarettes, in cigarettes that are made and smoked, this is not happening.

Q. You have not done any research to confirm that doesn't happen, correct?

A. Well, as I say, it is not clear to me how you would do that, but it is clear that it doesn't happen.

Q. That's just because you know.

A. Yeah.

Q. Are you speculating?

A. No.

Q. You are not speculating, you absolutely, positively know?

A. Yes.

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Q. But yet you haven't done any research to confirm that, correct?

A. Correct.

Q. When you say that some people have died as a result of smoking are you speculating or do you know that?

MR. HOEFMANN: Object to the form of the question.

THE WITNESS: I am sorry, what did you say I said?

Q. (By Ms. Hoag) When you said it is more likely than not that some people die as a result of smoking, were you speculating or do you know that?

A. Well, you know, we have had this conversation 10 times. That is what the -- that's the epidemiological finding.

Q. But is that speculation or do you know that?

A. I am sorry, I don't understand your question. That's the epidemiological finding.

Q. Is your opinion concerning those epidemiological findings speculation on your part or do you know it?

A. You know, have I done research, do I personally know these things, no, I don't.

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Q. So is your opinion concerning the epidemiological findings speculation or do you know it?

MR. HOFFMANN: Object to the form of the question.

THE WITNESS: We are going round and round in circles. The epidemiological findings are what the epidemiological findings are.

Q. (By Mr. Hoag) I guess I am asking because without any research at all you know this research published by Pankow is wrong, isn't that your testimony?

MR. HOFFMANN: Object to the form of that question, too.

THE WITNESS: There is some experimental data in Pankow's article which I have no basis to question the experimental data. What I said to you before we even had the article in it, as you appreciate it is a pretty lengthy and detailed article, is that there are some conclusions drawn that I don't believe are supported or kind of not aligned with what is actually in the article and I could give you a few specifics on that but I

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haven't had time to go through the whole thing. So let me just at this time rephrase it again to make it totally clear.

MR. HOFFMANN: Have you answered his question, his last question?

THE WITNESS: I think so, yes.

MR. HOFFMANN: Then there is no question pending.

Q. (By Mr. Hoag) Do you feel you have answered this question to the best of your ability now?

A. The question you asked me about Pankow's paper? I am sorry, I have lost tract. You can ask me a new question or we can have the reporter read something back.

Q. Let me ask you another question.

A. Okay.

Q. In the abstract going down to the eighth line, it says about the fourth word on the eighth line, beginning with the fourth word of the eighth line, The ability of ammonia to increase the amount of nicotine in the gas phase as compared to the particle phase was measured and confirmed, end quote. Do you agree with that?

A. Yeah. Let's put that part in the context

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of the experiment he did which was he passed cigarette smoke over the filter and passed ammoniated air over the filter to see if that would blow some of the nicotine out of the particle phase. So, yeah, I mean, that particular experiment, he describes that experiment and under that circumstance which is not the smoking of a cigarette but this is carrying a current of ammoniated air over smoke which has been deposited into a filter, that releases nicotine. Yes. I don't dispute that experiment.

Q. And he said his experiment, moving on a couple of lines down, was found to reduce the K and the small P, how do you read that, K and small P?

A. You would say K sub P. He defines K_p either on the next page or one of the pages basically as the -- it would be like ratio of how much vapor phase and how much in the particulate phase, a distribution between the two.

Q. What he is saying here is, correct me if I am wrong, I will ask what he is saying, is the value for partitions of the nicotine tobacco smoke particulate matter was reduced by more than a hundred fold.

A. Yeah. Well, I mean, if he has a

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particular concentration of ammonia that is a hundred ppm in the air he is blowing over this filter, then he can blow off a hundred times more, basically he can blow off a hundred times more nicotine than if he was just trying to blow it off with air.

Q. It goes on to say in that abstract, two more lines down, because gas-phase nicotine deposits more readily in the respiratory tract than does particle-phase nicotine -- let me break that down.

Do you agree with what he says in that first line, gas-phase nicotine deposits more readily in the respiratory tract than does particle-phase nicotine?

A. I think that is likely. I don't know of any experiments being done to prove that but I wouldn't dispute that particular part of it. But I don't think that is of any great relevance because I think that virtually all nicotine that gets inhaled whether it is in the gas phase or not gets deposited into the respiratory tract anyway.

Q. He says because free-base nicotine is more lipid soluble than is protonated nicotine, do you believe that?

A. In isolation, yes. In fact when the

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particle of nicotine smoke is deposited in the respiratory tract you have this physiological fluid but it will go to pH of the physiological fluid.

Q. What is lipid soluble?

A. Lipid is a fat.

Q. It is more fat soluble?

A. Yeah.

Q. What is protonated nicotine?

A. Well, nicotine chemically is a base and when it is protonated, either one or two hydrogen ions are added to it, it is either protonated nicotine or nicotine in a salt form.

Q. Pankow and the other authors of this article marked Plaintiff's Exhibit 1 say that because of the two things we discussed, the gas-phase nicotine deposits more readily in the respiratory tract than does particle-phase nicotine and because free-base nicotine is more lipid soluble than is protonated nicotine, they go on to say such a reduction in K_p will increase the availability of nicotine from MSS as well as from freshly formed ETS particles. Do you agree with that?

A. Well, as I say, you take each piece in isolation it is true but the whole thing is irrelevant because the MSS particles that are

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inhaled or the nicotine, virtually all the nicotine gets absorbed anyway, irrespective of the pH of cigarette smoke.

Q. So you do agree that based on what they have written here in the abstract that it will increase the availability of nicotine from mainstream smoke?

A. Well, not really because the nicotine is a hundred percent available anyway. You know, you don't need to increase it, it is all available there.

Q. Well, crack cocaine is a form of cocaine, correct?

A. Correct.

Q. If it is in the form of crack, it is still a hundred percent available, correct?

A. Let's go to Page 3 because this is where he talks about this, I think. Page 3 of 11, second paragraph.

Q. Second paragraph where he says -- I will be happy to go there now -- second paragraph where he says, The above view of the role of ammonia in tobacco smoke is analogous to what occurs when the alkaloid cocaine is free based, or used in crack form.

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A. That is where he is totally wrong, this isn't based on any scientific experiments, this is a lack of understanding on his part of what is happening in that nicotine is present in tobacco as a salt but the nicotine is volatilized and gets transferred and gets into the particles again as nicotine salts. My understanding is -- and I haven't done this experiment -- but my understanding is if you put, just put cocaine hydrochloride period on tobacco the heat of combustion destroys most of it so you don't get the cocaine transferred. So the reason people do this free basing of the cocaine has to do with trying to get it transferred into the smoke and that is why it is done. So this paragraph in my view, he has got muddled up and it is wrong.

Q. Let's take it line by line and you can explain what your opinion is of each line of that paragraph.

The next sentence, the next sentence of that paragraph which is on Page 3 of the exhibit says, Free-based cocaine and crack are typically prepared by reacting, quote, street cocaine, usually the HCl salt of cocaine, with aqueous ammonia and sodium bicarbonate respectively. Do you agree with that sentence or do you have problems with it?

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A. Well, I have no reason to dispute it, but I have no firsthand experience of that.

Q. The next sentence says, In both cases, the result is the more lipid-soluble, free-base form of cocaine which is then smoked. Do you agree or disagree or have no opinion on that sentence?

A. Well, I disagree with that sentence which doesn't actually -- now we are looking at it line by line. I mean, it doesn't even make grammatical sense, I think, for what is going on, what he is trying to talk about. But the results of the aqueous ammonia and sodium bicarbonate treatment as I tried to describe before is to free up the cocaine from the cocaine hydrochloride so it can actually transfer into the smoke, otherwise it breaks into other chemicals that are no longer cocaine. This isn't what happens with the nicotine transfer. Nicotine transfers from nicotine salts. So as an analogy, it is incorrect, it is wrong.

Q. Then do you disagree that the result is the more lipid-soluble free-base form of cocaine?

A. No. The result, is that the result of this free basing is to make the cocaine transfer so that the user of the crack cocaine essentially gets some crack cocaine as opposed to the deposition

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products of cocaine, whatever they may happen to be.

Q. Next sentence is, Smoking volatilizes and aerosolizes the free-base cocaine. Do you agree with that, that smoking volatilizes and aerosolizes the free-base cocaine?

A. That is apparently what happened, yes.

Q. Which goes on to say, which is rapidly absorbed into the body. Do you agree with that?

A. I have no reason to suppose that's wrong.

Q. And also goes on to say that this results in leading to an immediate and intense high that is said to be comparable of that obtained with an intravenous ingestion of cocaine. Do you agree or disagree or have no opinion?

A. I don't disagree with it. I have never read reference 12, but I have no direct knowledge of it. I have no reason to dispute that.

Q. And the next sentence says, In this paper we demonstrate the ability of gaseous ammonia to increase the availability of nicotine from both mainstream and ETS particles. Do you agree with that, that statement?

A. In his experimental setup where he was passing gaseous ammonia over smoke collected on filters, yes.

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Q. Yes, you agree with the fact that paper does demonstrate that?

A. Not the availability. He didn't do that. He looked at the smoke collected in filters and passed ammoniated air through that, showing that released more ammonia than pure air by itself.

Q. Going back to Page 1 of the article, the introduction, the first sentence of that introduction says: The base ammonia, as well as ammonia-forming compounds such as diammonium phosphate, DAP, and urea is routinely added to the tobacco used in domestic cigarettes. Do you agree with that?

A. Largely. Just for clarification, the base ammonia per se is used during the manufacture of some forms of reconstituted tobacco, so ammonia per se is not added to the tobacco because it would just evaporate, disappear.

Q. Does the use of ammonia increase as well as control the delivery of the alkaloid nicotine to the respiratory tract of the smoker?

A. No.

Q. Does it increase the alkaloid nicotine to the respiratory tract to the smoker?

A. Not in the amounts used, no.

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Q. How much would you need to see to increase the alkaloid nicotine to the respiratory tract of the smoker?

A. I don't know. But I don't think it would be practical. I think the thing would start tasting like a bottle of ammonia smells so it wouldn't be an attractive proposition.

Q. Page 2, there is a quote from the leaf blenders manual. Have you ever seen this leaf blenders manual?

A. Yes.

Q. When did you have occasion to see that?

A. Sometime. It was put together, if I remember correctly, I think after my retirement. And at some point in preparation for some deposition, I am not sure which one, I probably looked at it.

Q. Who put it together, the leaf blenders manual?

A. Well, it was compiled by a number of people working in Brown & Williamson's R&D.

Q. Who were those people?

A. I don't recollect the names off the top of my head.

Q. Did you know any of those people?

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A. Well, give me some names and I can tell you.

Q. Well, I was hoping you would have the names in your head of some of the people who worked on it, but if you don't, at the break I will have to pull that.

A. Sure. Why don't we do that.

Q. I will just write myself a note to do that.

Now, the individuals, approximately how many people worked on that leaf blenders manual?

A. Well, I mean, you are going to pull it out and find out so why don't we wait until we find out.

Q. Did you have occasion to speak to any of the people that worked on the leaf blenders manual after the point you reviewed it?

MR. HOFFMANN: You mean about the manual?

THE WITNESS: I don't think I did, no. I mean, you said I reviewed it, I looked at it at some point in the course of preparation for some litigation. I mean, until we know who the authors are for sure, I won't know if I talked to any of them specifically about

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bits and pieces of it. Why can't we wait until we have it and then I can probably answer you more sensibly.

Q. (By Mr. Hoag) The person who showed you this leaf blenders manual, was that an attorney?

A. Probably but I can't remember.

Q. Have you been asked questions about the leaf blenders manual in prior depositions?

A. I am not sure.

Q. On Page 2 of Plaintiff's Exhibit 1, second paragraph quotes from the leaf blenders manual in the following quotation, Ammonia, when added to a tobacco blend, reacts with the indigenous nicotine salts and liberates free-base nicotine, period.

Do you agree with that?

A. If you added enough. You are going to ask me how much is enough, I am going to say I don't know. If you added enough it would but the amounts added and the types added in commercial practice, that doesn't happen.

Q. What are indigenous nicotine salts?

A. Well, the nicotine is a component of tobacco and in the plant it is not present as the nicotine molecule but as a compound between, say,

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nicotine and say citric acid or tartaric acid or whatever the acids are that one finds in tobacco. I am trying to remember some of the names now, mellitic acid. So those would be the nicotine salts, for example, nicotine malate or nicotine citrates.

Q. Now, what would be the process whereby when added to tobacco the ammonia would react with the indigenous nicotine salts and liberate free-base nicotine?

A. Well, as I said, let's leave tobacco aside for a moment but if you had some nicotine titrate or citrate and added some ammonia to it, some of the ammonia would become ammonia citrate or ammonia titrate then there would be nicotine.

Q. Next sentence in that paragraph quoting the leaf blending manual states, As a result of such change, the ratio of extractable nicotine to bound nicotine in the smoke may be altered in favor of, in parentheses, free-base, nicotine. Do you agree with that?

A. No. Because there are two parts we have to take. Overall the answer is no. And the question is because there is not enough ammonia and then extractable nicotine needs further definition

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which I suppose we will get on to in a moment.

Q. You do agree with what the authors of the leaf blenders manual wrote; is that correct?

A. If that is a direct quotation from them, I would agree that is what they wrote.

Q. The people who wrote the leaf blenders manual were employed by Brown & Williamson at the time they wrote it, correct?

A. Yes.

Q. The people who wrote the leaf blenders manual were scientists?

A. Let's wait until we get the names and we can verify that.

Q. Without looking at the names, do you know that now at least some of authors of the leaf blenders manual were authorities?

A. If authority is having knowledge, yes.

Q. Then in the next exhibit paragraph, As we know, extractable nicotine contributes to impact in cigarette smoke. Do you agree with that?

A. No, because the extractable, i.e., free-base is a misunderstanding of how extractable nicotine is a laboratory test, extractable nicotine is not necessarily free-base nicotine.

Q. You said not necessarily free-base

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nicotine.

A. Right.

Q. Does that mean sometimes it is?

A. Part of it is but only a small amount of it, it depends on doing the measurement, depends on the pH of the various solutions you are working with.

Q. What is the difference between free-base nicotine and other nicotine?

A. Well, we have talked before about nicotine salt which is protonated nicotine and free-base nicotine which is unprotonated nicotine. It turns out that extractable nicotine as defined in a British American Tobacco Company developed test method was they would collect cigarette smoke on a filter and then shake that up with water and chloroform and then measure how much nicotine was in the water and how much has chloroform. What was the chloroform, it was in the extractable nicotine, the amount that could be extracted from the aqueous slurry of cigarette smoke.

Now, the writer here on this page erroneously assumed that all that stuff was unprotonated or free-base nicotine and that is incorrect. I am going to continue now.

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MR. HOFFMANN: I don't think there is a question pending.

Q. (By Mr. Hoag) Were you finished with your answer?

A. No. I know this -- well, I am not sure whether -- it is very long but I haven't quite finished what I am saying.

So what I said was this BAT test method which correlated the amount, which determined the amount of total nicotine which was extracted from an aqueous slurry by chloroform so this was some nicotine salts and some small amount of unprotonated nicotine and there was a correlation in that test method between this extractable nicotine as measured in this test tube test and smoke panel sensations of nicotine impacting cigarette smoke. But the last part of the sentence is invalid because it had nothing to do with it.

Q. When you say last part of the sentence, you mean the part that says, and this is how ammonia can act as an impact booster?

A. Yes, because it doesn't.

Q. So you are saying that the authors of the Brown & Williamson leaf blender's manual were wrong; is that right?

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A. In the last half of this sentence, yes.

Q. So can ammonia act as an impact booster?

A. I know you don't like asking me question, if you smell a bottle of ammonia, it smells pretty pungent. If you had a cigarette doused in ammonia, that is what it would taste like, but that is not what people buy or smoke. So in normal commercial usage ammonia does not boost impact.

Q. By impact, I was referring to the impact of nicotine.

A. Well, I mean, I am grateful to you for saying that because I need to define what I mean by impact, make sure it is what you are asking me.

Impact is a sensation in the back of the throat that smokers perceive when they inhale cigarette smoke. It is a momentary sensation. It appears to be associated with the amount of nicotine in the smoke, but it is another one of these examples you don't know in time there is cause and effect, there would be other substances in the smoke impacting the effect, too. It is not clearly understood.

Q. You don't consider impact to include the effect the nicotine has on the brain; is that correct?

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A. I am sorry, I don't think that is -- that is not a very meaningful question. Impact is a sensation that a smoker observes when they inhale smoke, it is a momentary sensation on the back of their throat. That in and of itself doesn't have anything to do with any subsequent neurophysiology.

Q. So your definition of impact is limited to some feeling that the smoker gets in the back of their throat rather than any feeling they get as a result of nicotine going to the brain; is that correct?

A. I think that's a fair statement, yeah.

Q. Now, this sentence in the leaf blender's manual, let me read it again and ask you a question again. It said, As we know, extractable, in parentheses, i.e. free-base, end parens, nicotine contributes to impact in cigarette smoke, and this is how ammonia can act as an impact booster.

My question to you is, what does the nicotine contribution have to do with the impact in the back of somebody's throat rather than the impact in their brain?

A. Well --

MR. HOFFMANN: Object to the form.

Answer it if you can.

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THE WITNESS: I don't know what you mean by impact in the brain; but if this sentence had read, as we know extractable -- omit the part in parentheses -- as we know extractable nicotine correlates with impact in the back of the throat in a cigarette smoker, that by itself is a true statement. The appended part about ammonia is incorrect.

Q. (By Mr. Hoag) Has the leaf blenders manual been altered, revised or discontinued to your knowledge?

A. To my knowledge, I don't know if it has been revised or not. No, I don't know.

Q. The next paragraph says --

MR. HOFFMANN: John, could we take a real quick break before we go to the next paragraph.

(A recess ensued.)

Q. (By Mr. Hoag) Before we go back and start asking questions of the witness, I have the leaf blenders manual, Exhibit 1677. Do you have that?

A. No.

MR. HOFFMANN: Not in the room.

MR. HOAG: While I am asking these

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other things, can someone see if they can locate it?

MR. HOFFMANN: Yes.

MR. HOAG: Should I go on while that is being done?

MR. HOFFMANN: Sure.

Q. (By Mr. Hoag) Before we took the break, I was about to start asking you questions about Page 2 of Exhibit 1, Paragraph No. 3. Referring to that paragraph, it discusses the 1983 BATCO, British American Tobacco Company, research conference in Rio de Janeiro. Were you present at that research conference by any chance?

A. No.

Q. Did you ever go to any BATCO research conferences?

A. Yes.

Q. What is BATCO?

A. It is the British American Tobacco Company.

Q. Did they have conferences in other parts of the world sometimes that you attended?

A. Yes.

Q. Did they confer with other corporate entities that were outside of the United States?

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A. Well, like do you mean sister tobacco companies like the Brazilian Tobacco Company?

Q. Other than BATCO, did they communicate with any other tobacco companies at these conferences?

A. Who is they?

Q. The people that work for the British American Tobacco Company.

A. The people with the British American Tobacco Company typically, people from Brown & Williamson Tobacco Company, people who work with the Compania Sousa Cruz which is the Brazilian Tobacco Company, the German BAT company, Cigarretten Fabriken, and people from an associated company in Canada, Imperial Tobacco Company of Canada.

Q. How many of these conferences with different groups of scientists from different affiliated organizations were in attendance did you attend?

A. Well, over my total career, conferences where there were scientists present for most of these companies, maybe a dozen.

Q. What was the purpose of those conferences?

A. Well, there were different conferences

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addressing different subjects, I mean, there might be a conference on analytical testing methods or there might be a conference on R&D programs or there might be a conference on aerosols or on filters or something. So there was some specialist conferences and some general conferences.

Q. So it was a frequent occurrence that you would share information among the different affiliated organizations: is that right?

A. Depends on how you define frequency but there was sort of a general get together usually every year and then specialist conferences on an ad hoc basis.

Q. And was internal research shared among these various groups?

A. Oh, it would depend again on what the conference was about. If it was a conference to discuss how filters worked, then people would bring experimental results on filters; but if it was a conference on what should we be doing next year, it wasn't a question of sharing research, it was more discussing what we should be doing next year.

Q. Now, this sharing of information, you wouldn't share this information with like, for example, Philip Morris people, correct?

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A. Correct. This is mostly trying to gain a competitive advantage.

Q. So all of these groups that you have named, they worked together to gain a competitive advantage, correct?

A. Well, each company had competitors in whatever country it was operating in in general. Probably Philip Morris was the major competitor to a particular company, a particular place.

Q. Do you know if any documents, Brown & Williamson documents, were moved from the United States to other parts of the country?

A. Sorry. Could you restate that.

Q. I am not sure how to. Let me try, though.

MR. HOFFMANN: I am going to object to the form, but then we will see how your next question comes out.

Q. (By Mr. Hoag) Do you know whether any documents that were in the United States -- and I am specifically referencing scientific research documents -- that were in the United States were at some point moved out of the United States to another country?

MR. HOFFMANN: I am going to object to

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the form.

Q. (By Mr. Hoag) You can answer.

A. Well, I don't know of that occurring.

Q. Do you know if any research projects were moved out of the United States from the United States to other countries or another country?

MR. HOFFMANN: Object to the form.

THE WITNESS: Well, I am going to answer, I can give you a specific. We were doing most of the work in Brown & Williamson trying to develop a product to compete with the cigarette or smoking article produced by R. J. Reynolds called Premiere. This work was going on in the mid to late 1980s. We weren't making very much progress in being able to do this in Brown & Williamson and we said we just don't have enough fundamental knowledge about this and let's move this work over and let's have British American Tobacco Company do this work in Southampton, England.

That's an example of a research project that was being worked in Brown & Williamson, we weren't getting anywhere, we moved it to a laboratory in Southampton for them to work on.

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Q. (By Mr. Hoag) Can you think of any other examples?

A. No, which is not to say that from time to time because we didn't want to have a redundant effort, we might have, for example, got British American Tobacco Company in Southampton, in Germany to concentrate on developing an analytical method for measuring the amount of side stream smoke, for example, we asked them to get that done, we would just pick up the method in Louisville.

There is probably a number of examples of that, but I can't think of others offhand.

Q. Some things were moved from Brown & Williamson, meaning B&W, to BATCO, correct?

MR. HOFFMANN: Object to the form of the question.

Q. (By Mr. Hoag) Is that correct?

A. Well, I have given you a specific example of a development project and I said it is possible some analytical method development projects were done in the British American Tobacco Company lab rather than the Brown & Williamson lab, but I can't think of a specific.

Q. Now, you said that B&W was working on a product that was similar to the Premiere, what was

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that called?

A. Well, the name of the project was Airbus.

Q. Airbus.

A. Yes.

Q. Did they ultimately develop a product?

A. No.

Q. Why?

A. Well, I mean, I guess because we weren't (indicating).

Q. Because what?

A. Because we weren't clever enough, capable enough, whatever.

Q. How long did the project Airbus last?

A. A good two years, then probably some more time over at British American Tobacco.

Q. What was the goal of project Airbus?

A. Well, it was to develop a smoking article that would be classified as a cigarette, that would deliver a smoke composition similar to that of Premiere cigarette, and be preferred by consumers over the Premiere cigarette.

Q. Did they develop any prototypes at all?

A. Not anything that would go beyond the laboratory.

Q. Were you involved in that research in any

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way?

A. The people that worked on it reported through me, yeah.

Q. What was your position at that time?

A. I was, I think, director of research.

Q. What year was this?

A. Well, that is what I am trying to tell you, '87, '87-ish.

Q. Did they run any tests on the prototype?

A. Well, I don't think we ever got to the point where there was anything you would even take a puff on without a great deal of reticence, so no. We did not run any consumer tests, no.

Q. Or any research like RJR did in their lengthy monograph?

A. No. We didn't get anywhere near that far.

Q. You are familiar with RJR's monograph concerning their cigarette, correct?

A. I have seen a book about -- yeah. I think I know what you are referring to. It would be a book which describes the product which was marketed as Premiere, contains various test results, including some animal tests and so forth. I have seen that, yes.

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Q. So was that Premiere product marketed to be a safer cigarette?

A. I don't think there were, you know, I can't speak for R.J. Reynolds marketing.

Q. Well, you are familiar with what was the Premiere product and what its results showed about levels of carcinogenic compounds, correct?

A. That is ten years ago. I don't remember the results. My overall take away of the results, trying to think back ten years, is this product produced smoke which for all practical purposes didn't give any responses in any of the biological tests that were particularly, that were often used to test the biological activity of cigarette smoke.

Q. Was it a safer cigarette?

A. Well, let me answer that in two parts. This particular cigarette did not, apparently, have any biological activity in any of the tests that were undertaken or minimal biological activity, therefore it is kind of hard to see that it would have any activity on a user. Whether cigarettes normally made were safer or unsafe is a totally different question.

Q. So are you saying this particular cigarette was a safer cigarette?

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MR. HOFFMANN: Object to the form of the question.

THE WITNESS: Try that again.

I will try it again. We, Brown & Williamson, don't make any representations about the safety of cigarettes one way or another. But many health authorities or all health authorities do and say that cigarettes are unsafe. I don't know whether health authorities view this project, this product of R.J. Reynolds, as more or less safe. I don't know what their view was.

Q. (By Mr. Hoag) Well, do you have an opinion, a personal opinion as a scientist as to whether or not the RJR Premiere cigarette was a safer cigarette, safer than those on the market today?

MR. HOFFMANN: Object to the form of the question.

THE WITNESS: I will just try to answer you again. It is going to be two parts. There was nothing that I saw or can recollect to indicate that the RJR Premiere product had any biological activity; and with regards to ordinary conventional cigarettes I am not

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making any representation they are safer or unsafe.

Q. (By Mr. Hoag) I understand that answer but what I am asking you is do you have an opinion as a scientist.

MR. HOFFMANN: Object.

Q. (By Mr. Hoag) I understand what your understanding of policy of the corporation is, Brown & Williamson and BATCO, but what I am asking you is your opinion as a scientist.

MR. HOFFMANN: I object to the form of the question.

Q. (By Mr. Hoag) Do you believe as a scientist that the RJR Premiere was safer than the cigarettes that are on the market today?

MR. HOFFMANN: I object to the form of the question. It has been asked and answered and he has not said anything about what the policy of the company is. He has given his answer to that question twice.

Q. (By Mr. Hoag) You can answer.

MR. HOFFMANN: I will let you answer it the third and last time.

THE WITNESS: As a scientist, my opinion is that the data provided on the RJR

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Premiere cigarette indicated that it has no biological activity and as a scientist I am not making any representation about the safety or lack thereof of Brown & Williamson cigarettes.

Q. (By Mr. Hoag) I am just looking over the article right now. I will be right with you.

Has anyone been able to find Exhibit 1677?

MR. HOFFMANN: Yes. But we have also gone back and reviewed Judge Postman's order entered on April 14th, 1997, which says, Prior to the use of any Brown & Williamson document referenced in a public source, e.g., for example, the Cigarette Papers Internet or news media, in connection with the deposition of the defendants' chief executive officers, any expert or other witnesses, plaintiff shall give B&W at or before the commencement of that deposition those B&W documents plaintiff intends to use at that particular deposition. There is an exception that doesn't apply here.

The prefatory language here says, Having heard argument of counsel and having

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considered written submissions on the same of whether plaintiffs can make use of certain documents reportedly taken from Brown & Williamson Tobacco that are potentially privileged. This document was, we believe, stolen from Brown & Williamson; and we have not had notice that you intend to use this document at this deposition, therefore we believe we have a basis to object to any questions based on the document at this deposition.

MR. HOAG: Let me clarify. Are you going to instruct him not to answer any questions or are you just going to object?

MR. HOFFMANN: I am going to put on the mute button. I want to discuss this among counsel for a minute. We will be right back.

(Discussion ensued off the record.)

MR. HOFFMANN: First, John, we thought we had the proper document but the paralegal brought up the wrong document so we have gone back and tried to fix that. Secondly, we believe technically that you should have provided us with notice prior to the

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deposition or the commencement of the deposition that you intended to use the document and you didn't do so, so we would be within our rights in instructing the witness not to answer any questions about the document; however, I will not do so as long as it is understood that I am not waiving my right to insist upon the application of the order to any other document that you might use during the course of this deposition; secondly, that I will have a continuing objection to each question on this document on the grounds that the document is potentially privileged insofar as it is a highly confidential trade secret; and third, that any questions and answers about this document pursuant to Judge Postman's order shall remain under seal in this deposition until such time as we have an opportunity to assert and litigate any privileged trade secret or confidentiality objections with regard to the document.

MR. HOAG: You are talking about any questions I ask right from now on about this particular document, you want those to be

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sealed until the judge makes a decision on whether or not those are unsealed.

MR. HOFFMANN: Under the leaf blenders manual, about leaf blenders manual.

MR. HOAG: I think that is a reasonable way to deal with this because obviously it would be inefficient for both of us to have to go back and redo the deposition at a later time to deal with this document. So I will agree with those conditions regarding that.

MR. HOFFMANN: Okay. I don't know if you want to take a break until the document gets here. I am sorry for this snafu. The paralegal just either misunderstood us or something. She came up with the wrong document. So we can either take a break or if you have some other areas you want to continue with while we are waiting for it, that will be fine, too.

MR. HOAG: I can go into some other areas right now.

Q. (By Mr. Hoag) What was the last position you held prior to retirement?

A. Director of research within the research and development department.

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Q. How long did you hold that position?
A. I think three years.
Q. What year to what year?
A. I retired in '91, so if it was three years it would have been '89 or '88 to '91. It might have been four years, might have been '87 to '91.
Q. What was your last salary when you held that position?
A. Well, I think base salary was about $113,000 a year.
Q. Did you own any stock in the company?
A. No. I didn't at that time and I don't now.
Q. At one time you did own some stock in the company?
A. Not stock in Brown & Williamson, I had some BAT Industries shares at one time.
Q. Were there any other forms of compensation other than the $130,000 of salary?
A. $113,000.
Q. 113?
A. Yeah. There were two, there was one, something called profit sharing which depending on how well the company did was of the order of 5 to 10

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percent of base salary; and something called incentive, executive incentive program which depending on how well the company did was anything from about zero to 20 percent of base salary.

Q. So $113,000 base salary, 5 to 10 percent in addition to that based on profit sharing; is that right?

A. Yeah.

Q. There another portion just for executives that could be as much as 20 percent in addition to that.

A. Right.

Q. Other than that, was there any other form of compensation you received?

A. No, nothing direct. There was a paid health insurance and life insurance.

Q. Did you ever have stock options or anything like that?

A. No.

Q. And Jeffrey Wiggand, he was your supervisor at one point, correct?

A. Yeah. His name is Wiggand.

Q. It is like my name, you can pronounce it lots of ways.

What year or years did he supervise you?

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A. Well, it was from whenever he came until I retired, and here I get a little muddled up, if he came in January of '88 or January of '87. I think it was probably January of '88, unless it was '89. I am sorry to be vague.

Again, that's a matter of somebody's record somewhere. Two or three years he supervised me.

Q. What was his position with the company at the time he supervised you?

A. Vice president of research and development.

Q. Was that the first position he ever held with the company?

A. Yes.

Q. What were his duties as vice president of research and development?

A. Well, as I understood them, he was the manager for all the R&D activities that were undertaken in Brown & Williamson's R&D department. Prior to his coming there had been a period when we did not have a vice president of research and development, and I managed half the department and a colleague of mine managed the other half of the department. There was a director of research and

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the director of product development.

Q. Did he actually prepare evaluations of your work?

A. Of my performance, yes.

Q. Written evaluations?

A. Yes, yes.

Q. What kind of performance evaluations did he give you?

A. Wonderful.

Q. Excellent evaluations?

A. Yes.

Q. You got the highest possible evaluations from --

A. I don't know that it was a score of like 9 out of 10 but they were overall positive.

Q. Did you meet with him on occasion?

A. Well, yeah, almost daily.

Q. Were they one-to-one meetings or were there other people present?

A. Both.

Q. How would you characterize him as a supervisor?

A. A very complex individual who had some strengths but a lot of weaknesses.

Q. What were his strengths?

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A. He had come from a background at least in part of clinical research labs, so I had a fairly good understanding of how he had a fairly good understanding of how to perform a lot of routine laboratory testing; and he helped us there, I think, increase our throughput of analytical samples and do that operation more effectively.

Q. Did he have any other strengths?

A. He was, I think, trained as a biochemist and he says he knew more biochemistry than me and as best I could tell he had reasonable knowledgeable in the area of biochemistry. Those are the ones that come immediately to mind.

Q. He had a Ph.D.; is that correct?

A. Yes.

Q. His Ph.D. was in biochemistry?

A. I believe so, yes.

Q. Do you know whether he was recruited by the tobacco company to work for Brown & Williamson or not?

A. Well, he was recruited by somebody to work for Brown & Williamson. My understanding is that a search firm located and found him.

Q. What position did he hold prior to becoming vice president, a vice president?

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A. Before he worked for Brown & Williamson, my understanding was he was unemployed, working as a consultant.

Q. So it is your understanding they hired this unemployed person in 1988 to be your supervisor?

A. As I said, at the time he was hired, my understanding was he was working as a consultant. I believe before that, there was a Wall Street article about this, he worked for a company that made penile implants or something along those lines. It is a matter of record. I can't help you beyond that.

Q. What were his weaknesses?

A. A bully, a liar, a cheat.

Q. Anything else?

A. Not a very good listener. Not a good people manager.

Q. Anything else?

A. I think others probably of a lesser importance, not necessarily a very good manager of time.

I have finished for right now.

Q. Did you experience all of those negative qualities personally?

A. Lying and cheating, yes; he didn't bully

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me, but I have seen him bullying people.

Q. Why do you figure he didn't bully you?

A. Either because -- gosh, we are getting into speculation here. I guess he assumed it wouldn't work.

Q. When did you first discover that he was, in your opinion, a liar and a cheater?

A. Well, probably cheating fairly early on but this is in a trivial context, playing racquetball. Later on -- I didn't play golf but he did -- people came and complained to me about him cheating at golf, didn't know what to do about it. I guess that happened with other people in the company, too.

Bullying was something that evolved more but continued throughout the time I was employed there and it waxed and waned. I guess basically he had a mean streak. If someone crossed him he took it out on them.

Q. So the lying and cheating, your personal knowledge of that is based on racquetball and golf, correct?

A. Yes.

Q. Anything else other than racquetball and golf?

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A. Not my personal, no.

Q. When you met with him almost on a daily basis, did he talk to you about the job and things like that? Was it job-related I guess is what I am getting at.

A. Yeah. Many things we would talk about that were job-related, yes.

Q. So you had conversations job-related with him on a day-to-day basis, correct?

A. Yes.

Q. Any of those day-to-day basis things where he lied to you?

A. You know, I can't recall the specifics so I don't know.

Q. Any of them where he cheatcd you in some way?

A. In work related things, no, no.

Q. In racquetball, did you play racquetball with him?

A. Yeah.

Q. How frequently did you do that?

A. Oh, probably up until he left Brown & Williamson. Even after I retired, I would play with him occasionally.

Q. So did you play with him once a week?

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A. No. Probably more like once a month.
Q. Once a month for several years?
A. Yeah.
Q. When did he first start to cheat at racquetball in your presence?
A. Probably the first time we played.
Q. Why did you keep playing with him?
A. I cheated more than he did.
Q. Well, who was the first one to start cheating?
A. He was.
Q. So you were a retaliatory cheater, right?
A. That's right.
Q. Did he catch you cheating or you just caught him?
A. I don't know.
Q. How did he cheat at racquetball?
A. Well, do you play racquetball?
Q. Yeah.
A. Well, he would pretend it hadn't bounced twice when it had.
Q. Anything else?
A. I can't recollect.
Q. What about golf, what lying and cheating did he do at golf?

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A. Okay. This is only reported me.

MR. HOFFMANN: John, I mean, you use your time any way you want but you represented to us you are going to be done at 4:30, right?

MR. HOAG: That's right.

Q. (By Mr. Hoag) What lying and cheating did he do at golf?

A. This is not based on any direct knowledge of mine, do you understand that?

Q. Right.

A. Basically I am not a golfer, so you will have to bear with me if I am not using the correct terms. But apparently you can move balls around when you are not supposed to do, something to do with improving lies. Not really finding a lost ball but dropping one out of your pocket, something like that; not necessarily counting all the strokes. But as I say, this is secondhand. I have no direct knowledge.

MR. HOFFMANN: John, you might be interested in knowing we have the leaf blenders handbook now.

MR. HOAG: Okay.

Q. (By Mr. Hoag) Again, in the day-to-day

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operations when Dr. Wiggand was your supervisor, did he ever give you any advice or any supervision that you considered to be inappropriate or lacking in competence?

A. My silence is I am thinking.

You know, on technical stuff, he was outside of the industry, so he pretty much relied on my knowledge, so he didn't give me technical advice about tobacco stuff because I obviously knew much more about it than he did. That wasn't the question.

We might have differed sometimes about, you know, personnel, should X be promoted or should Y be a particular job, but I am not questioning competency there, that is a disagreement people would have that would work with each other from time to time.

Q. So he respected your abilities and he didn't contradict them when you said something; is that right?

A. I believe that's correct in general, yes.

Q. Did he ever pretend he knew something he didn't really know?

A. Yeah. Not to me but he might have done to other people in my presence and I would have

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corrected him afterwards but not in public.

Q. Well, what in your presence did he, would did he pretend to know something he didn't really know?

A. I am saying in general terms in some discussion he might have free wheeled and I would have filled him in afterwards but none of these things are any great big deal.

Q. So nothing really comes to mind right now, correct?

A. Correct.

Q. Have you read his deposition, taken by Ron Motley?

A. No, I haven't.

Q. When did Dr. Wiggand leave the company?

A. Well, it is a matter of record. I think might have been early in 1993, but I am just not sure.

Q. Do you know why he left?

A. I think he was asked to leave by Mr. Sandifer.

Q. Do you know why he was asked to leave?

A. Not directly, no.

Q. Do you know Mr. Sandifer?

A. I did, yeah.

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Q. How did you know him?

A. Well, he was the president of Brown & Williamson at one time and my immediate supervisor before Wiggand came and before his death Mr. Sandifer was chairman of Brown & Williamson.

Q. So did Mr. Sandifer have occasion to share with you his opinions and impressions of Mr. Wiggand?

A. No, he didn't.

Q. So you don't have any personal knowledge concerning the reason Mr. Wiggand left the company, or do you?

A. No. As I say, my understanding is he was asked to leave, I said, by Mr. Sandifer, it may have been by his immediate supervisor Mr. Kohnhorst. But no, I don't have any direct or personal knowledge.

Q. Did any people in the company who supervised Mr. Wiggand share with you the reason he was asked to leave if in fact he was asked to leave?

A. The only comment I can remember at one time from Mr. Kohnhorst, this was before he was --

Q. Mr. Who?

A. K-o-h-n-h-o-r-s-t, who was the executive vice president of Brown & Williamson and Wiggand's immediate supervisor.

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Q. What comment did he make?

A. I asked him at one time, I guess this is about six months before Wiggand left the company, how Wiggand was doing; and Kohnhorst said, not very well, we have lost trust in him. But that was, you know, that was the substance of the conversation.

Q. He didn't explain why they lost trust in him?

A. I think it was dishonesty but what kind of dishonesty or so forth, I don't know, I didn't pursue that.

Q. Do you agree that nicotine is associated with impact satisfaction?

MR. HOFFMANN: Object to the form of the question. Answer it if you can.

THE WITNESS: Nicotine is associated with the impact sensation in the throat. I don't use the term myself impact satisfaction, I am not sure who does and in what context.

Q. (By Mr. Hoag) Do you agree that nicotine is associated with a pharmacological effect that goes across the blood brain barrier?

A. I don't find that a meaningful question. I would accept that nicotine has pharmacological

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effects.

Q. That go across the blood brain barrier, do you agree with that?

A. Nicotine has pharmacological effects in both the central and peripheral nervous systems. For it to have central effects it has to cross the blood brain barrier.

Q. It crosses that barrier within ten seconds of the time someone inhales a cigarette, correct?

A. I believe that's the order of the time taken, yes.

Q. Would you agree that below a certain level of four-tenths milligrams of nicotine that satisfaction is not sustained in smokers?

A. I don't know. It can go either way, but I don't think I would agree with that statement.

Q. You don't know why, you just don't think you would agree with it?

A. Well, I think there is enough -- again, when you think about that statement in and of itself, out of context, just hanging there, it is very meaningless anyway. Somebody could smoke a cigarette and get four-tenths of a milligram of nicotine from it and be perfectly happy.

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As I think about it I disagree with that sentence.

Q. Why?

A. Because someone could say I feel like having a few puffs of a cigarette, have a few puffs, take in four-tenths of a milligram of nicotine, put it out and go on their merry way.

Q. Do you agree to over 1.2 milligrams of nicotine becomes too harsh and has too much of an impact?

A. On a per cigarette basis, 1.2 milligrams on a per cigarette basis, I don't think so because there have been cigarettes marketed and sold successfully over the years that had higher levels than that.

Q. You said there were some that had higher levels.

A. Sure.

Q. I didn't quite catch that.

A. Sure.

Q Higher levels than 1.2 milligrams?

A. Yes.

Q. Which brands had higher than 1.2 milligrams?

A. I think you have to look at periods of

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time. But I think in the 1950s there were certainly cigarettes that had 1.8 to 2 milligrams of nicotine such as unfiltered Lucky Strike, Camel, Pall Mall. Again, these are a matter of record but those are the sorts of levels of nicotine in cigarette smoke at that time. In the '60s, 1.5 milligrams of nicotine on a per cigarette basis in smoke was pretty common.

Q. I am going to spell something for you, because I am not sure how to pronounce it, a-c-e-t-a-l-d-e-h-y-d-e, is that acetaldehyde?

A. Acetaldehyde.

Q. Do you know what that is?

A. Yes.

Q. What is it?

A. It is a chemical with CH_3, CHO.

Q. Is it in cigarettes?

A. I am not sure that there is any in cigarettes. In cigarette smoke there is about 700 micrograms from a full flavored cigarette.

Q. It is about 700 micrograms in the cigarette smoke?

A. Of a full flavored cigarette, yeah.

Q. Do you agree that it is an impact booster that augments the effects of nicotine?

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A. Acetaldehyde is?

Q. Yes. Do you agree it is?

A. I think I read someone suggesting that somewhere in the past, but I would not agree with it myself, no.

Q. Why don't you agree with it?

A. Well, because I don't think there is any, you know, anything to suggest that it is. As I said, someone apparently suggested it was at some time, but I don't see why it should be.

Q. You don't know why it should be and you don't know of any research that says it is or it isn't; is that correct?

A. Well, I don't know of any research that says it is or it isn't but, you know, my knowledge of chemistry and my understanding of chemicals based on that, acetaldehyde might have some effect on flavor and taste of cigarette smoke but I don't think it has any affect on impact sensation.

Q. What would it impact, taste and flavor?

A. It has a very distinct smell. If you smell a bottle of acetaldehyde, it smells like new mown hay but if you inhale some it is possibly a little scratchy on the throat, it might be a little irritating. It has a distinctive odor.

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Q. Do you agree that acetaldehyde enhances the synergistic effect of nicotine?

A. No. I have said I have hazy recollection of seeing a paper produced by someone, I don't think it was a Brown & Williamson person, on this subject.

Excuse me, I am coughing. I am going to get a drink of water.

But, no, I know of no reason why acetaldehyde should have a synergistic effect on nicotine.

Q. You do agree that acetaldehyde was or is an additive that is used in cigarettes, correct?

A. Let me make myself very clear here. Acetaldehyde is found in cigarette smoke, typically around 700 micrograms from a full flavored cigarette. I think some flavors a long time ago had some acetaldehyde in them. These are flavors that are added during cigarette manufacture. The amount of acetaldehyde added would have been in the micrograms and I think would have evaporated away from the cigarette. It is a very volatile material. Any that might have been added as part of a flavor mix wouldn't have been there by the time the cigarette was actually consumed. The

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acetaldehyde that is in the smoke comes from the combustion of the tobacco.

Q. Is that because it combines with other substances to form the acetaldehyde?

A. No. Acetaldehyde is a product of the combustion of cellulosic materials. If you burn some paper, there is acetaldehyde produced as acetaldehyde consists of carbon, hydrogen and oxygen which is cellulose which is what the plant structure and tissue of the tobacco is.

Q. Have you ever heard of the additive guidance panel?

A. Yes.

Q. What was or what is that?

A. Well, there may be one or may be two additive guidance panels or each company may have its own additive guidance panel. Let me speak with respect to Brown & Williamson's additives guidance panel. Basically it is scientists who would look at the additives proposed to be used in new flavor and determine if they were generally recognized as safe and therefore okay to be used as additives.

Q. Did Brown & Williamson have a group which consisted of two scientists and a lawyer that performed this function?

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A. I think that was the composition of the group at one time. It may have been more or less scientists, more or less lawyers at other times. When I say more or less, there may have been no lawyers at other times.

Q. When you were there, what was the composition of the additives guidance panel for Brown & Williamson?

A. Well, again, I think it varied over time. But there were times when it would be two scientists and a lawyer.

Q. What periods of time was that?

A. Probably most of the time I was there. I didn't get involved in this sort of part of the thing until probably about the 1980s, so from that time on.

Q. Were you one of the two scientists?

A. No.

Q. Who were the two scientists, if you know?

A. Again, it may have changed over time but there was somebody called Rosen, Jim Rosen; Esterle; somebody called Bill Denes, Bill Denes. I should say Rosen might have been the secretary to the panel, then Esterle would have been the other scientist. Art Diesing was secretary to the panel

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at one time.

Q. Who was the attorney or who were the attorneys that you can recollect?

A. One time it was somebody called Bob Sachs. I am not sure whether or not it was Kendrick Wells at another time, I just don't know. Again, it is a matter of record somewhere.

Q. What was the role of the attorney or the attorneys at the additive guidance panel?

A. I think to ensure that we complied with whatever laws pertained to this.

Q. The lawyer who sat or the lawyers who sat on the Brown & Williamson additives guidance panel, were any of those lawyers scientists?

A. No.

Q. Now, you recollected Kendrick Wells was one of the lawyers, at least one time.

A. I say I think he was after Bob Sachs but I am not a hundred percent certain, that would be a matter of record.

Q. What was Kendrick Wells' position at the time you are referring to, other than being an attorney?

A. Well, sometime or another he had the title assistant general counsel, I don't know if he

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had that title at that time or not.

Q. Are you familiar with a law firm Covington & Burling?

A. Yes.

Q. How are you familiar with that firm?

A. If I got this straight, I think I have, Covington & Burling is the law firm which acts as the clearinghouse for information about additives to be passed from the cigarette companies to the Department of Health and Social Services.

Q. Now is it your understanding that they were a central depository with this stuff, in order to protect confidentiality associated with the various additives company by company?

A. My understanding was each company provided a list of additives it used to Covington & Burling. Covington & Burling compiled these into a master list which passed through DHSS.

Q. The list they gave was a list based on volume and usage of specific additives, right?

A. Well, as far as I know it was a list of all the additives we used, but my memory is not any more detailed than that.

Q. Did it list which additives are used in each specific brand of cigarettes or was it just an

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overall list of all additives accumulated?

A. At the time I could recollect, it was a list, it wasn't brand specific, no, or wasn't even -- what I mean, each company put it in its list but they amalgamated for industry list is my understanding, I never actually saw what went to DHSS.

Q. This list was compiled by two scientists and an attorney at Brown & Williamson; is that correct?

A. I don't think the attorney compiled the list at all. The list was put together by the secretary of the additives guidance panel who had access to all the formulas for all the brands and all the ingredients that were supplied by the various flavor houses, so it was a scientist that compiled the list from our knowledge of the Brown & Williamson records of what was being made and what was being bought.

Q. Were the additives a matter of scientific interest to Brown & Williamson?

A. Well, from two aspects, yeah. First we wanted to ensure that the additives were safe to use as we used them and therefore if we didn't have sort of a toxicological profile of the additive we would

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get one, so it had to be safe and then of course it was of scientific interest in, you know, it would improve the taste or preference for the cigarettes.

Q. So it is your understanding that all of the additives used in cigarettes are safe when used as intended in a cigarette?

A. Yeah.

Q. What, if any, studies did Brown & Williamson do to test the synergistic effect, if any, of the additives in each brand of cigarettes?

A. I don't think that we looked to see if there was a synergistic effect but based on sort of the knowledge of the chemistry and our knowledge of compounds such an effect would be unlikely.

Q. That was your basis for the conclusion that the additives when taken together in each of the separate brands of cigarettes were safe; is that correct?

A. Yeah. You got to remember that the flavor additives really are minute quantities. There are some humectants like glycerine and propylene glycol which basically transfer unchanged. There has been a fair amount of pharmacological work done on the substances we used in large quantities.

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Q. You believe that to be true for all of the components of a cigarette including the tobacco itself, correct?

MR. HOFFMANN: Object to the form of the question.

THE WITNESS: I take the answer in two parts. There is tobacco which is a naturally grown substance which has been smoked for hundreds of years, and then cigarettes in their present form, roughly a hundred years or so when various things are added to tobacco to make it softer, more pliable, these so-called casings and then the flavors if you like give the cigarette a taste signature.

What I am saying is that the things that are added to cigarette smoke have, you know, no measurable biological effect in the quantities used.

Q. (By Mr. Hoag) Is that also true for the tobacco itself?

A. Well, I think we discussed earlier today, you can perform various biological tests on cigarette smoke in which various responses in the organisms are noted.

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Q. So has there ever been any test performed on the various combinations of additives in cigarette brands to see if any of them are biologically active?

A. Let me see if I understand your question. I just may, using an example, take menthol, you are saying has a cigarette with and without menthol been compared in a biological test, is that your question?

Q. We can start with that, yes. We will start with that question.

A. I can't cite you chapter and verse, but I am fairly sure a cigarette with and without menthol has been compared in a number of biological tests and there would be no difference in response.

Q. Now, I will try to explain my question or rephrase my question. First of all, what I am talking about is the potential synergistic effect of numerous additives when combined together in one brand of cigarette. Given that as my definition of testing the additives, have the additives in any brand of cigarette ever been tested to your knowledge for biological activity?

MR. HOFFMANN: Object to the form of the question.

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(The record was read by the reporter.)

THE WITNESS: I can't think right now of a test comparing, say, a cigarette with no additives versus a cigarette with a typical collection of additives. Those tests very well may have been done by some people inside or outside the industry. I can't recollect right now, though, of one.

Q. (By Mr. Hoag) Wouldn't it be necessary to do that before allowing millions of people to use the product?

A. Well, you know, I explained to you earlier that the additives were present in very small quantities and the flavor additives specifically that we are talking about and, you know, you would not expect to see any difference between a product with and without them.

Q. Isn't it true that one of the additives in at least some cigarette brands is formaldehyde?

A. I don't think so, no.

Q. How about arsenic?

A. No.

Q. Are any of the additives that you are aware of that are in any brand of cigarettes toxic in and of themselves?

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A. Well, again it is kind of a dose makes toxicity, if you eat enough sugar I think it is toxic. At the levels used it is way below any level of toxicity.

Q. Now, you will agree that there are occasions where a substance by itself isn't dangerous but when it is combined with another substance it then becomes dangerous due to the combination.

A. Well, I think I said to you this morning if you have sodium -- sorry, that was backwards way around. Things by themselves are dangerous; put them together, they were not dangerous. You know, you could have a chemical reaction where you can produce something dangerous from things that aren't dangerous but in the particular case of these additives they are sort of not those kind of things. We are talking about strawberry flavor and peach flavor.

Q. Is it your testimony the only additives are things like strawberry and peach flavor?

A. No. I said we are talking about things like that. I have also said that there are substances such as propylene glycol and glycerine but they transfer unchanged on smoking.

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Q. In answer to my question, which was is it true that sometimes a substance that is not toxic can become toxic when it is combined with another substance that is also not in and of itself toxic --

A. You are talking about the total universe of chemistry.

MR. HOFFMANN: You are not limiting yourself to cigarettes as we understand the question, is that correct? You are asking a basic question of chemistry.

MR. HOAG: I am asking a basic question of chemistry.

THE WITNESS: Not necessarily chemistry 101 but possibly 301 or something.

You know, I just have to assume. I am getting tired. I can't think off the top of my head. I haven't done a chemistry test in some time. It is likely there is chemical A you can react with chemical B to produce chemical C that is toxic even though chemicals A and B are not.

Q. (By Mr. Hoag) When you are talking about 50 different chemicals all interacting together at one time, then it just compounds the possible synergistic effect, correct?

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A. Except, you know, the chemicals that are used in these additives and flavorings are not reactive chemicals, they are not the kinds of things you use to do chemical reactions with. They are just relatively unreactive substances.

Q. Well, if they haven't been tested for their biological effect when combusted together, how would you possibly know they are safe?

A. Well, as I said before, from a general knowledge of chemistry, volatility transfer, potential breakdown products as they do pyrolysis, the amounts added, you could make some judgments and be sure that they are safe because any one particular additive is not vital to a cigarette's sale, so if you had any doubt about it -- my philosophy was if there is any doubt, throw it out, don't use it.

Q. Well, was it ever part of your philosophy to just test a group of additives together to see if your belief was confirmed?

A. No.

Q. Now, when cigarettes were in fact tested by Brown & Williamson for biological effects, did Brown & Williamson use what is known as reference cigarettes or did they use commercial cigarettes?

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MR. HOFFMANN: Object to the form of the question.

THE WITNESS: Well, there were, let me say number one, within Brown & Williamson laboratories we cannot do these, quote, biological tests. If work was done, it was performed outside under contract. It may have been specifically for Brown & Williamson or for example as was done by the tobacco working group in the 1970s under the auspices of National Cancer Institute. And typically there would basically be two ways of doing tests, one would be using a Kentucky reference cigarettes which was a typical U.S. cigarette at the time; the other would be if we wanted to see, for example, the effect of a filter additive, that may have been just with a typical Brown & Williamson product with and without that filter additive.

Q. (By Mr. Hoag) So whether it was under contract or done internally by Brown & Williamson --

A. We didn't do it internally at Brown & Williamson.

Q. When you say under contract, what do you mean?

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A. Well, I can think of a specific example where we went to Arthur D. Little and said we have a filter additive which we believe will show a difference in our biological tests. So that would be under contract.

Q. So when you had the filter additive that you thought would show a difference in biological tests, did you actually have Arthur Little, Incorporated, do that test?

A. Yes.

Q. What was the result?

A. I think that particular test they did, it had less biological activity.

Q. The filter additive did?

A. The smoke going through this filter additive.

Q. In other words, when you say biological activity there was less --

A. Response from whatever the test organ was. I can't remember. It was some kind of cilia, whether they were rat or frog, I don't know.

Q. You mean like fewer tumors?

A. No, no. This is a test of little cilia motility.

Q. What does cilia motility indicate?

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A. Well, it has been hypothesized at one time that cigarette smoke -- cilia are little things in the respiratory tract that sweep out mucus. It was hypothesized that cigarette smoke caused them to beat less frequently and therefore be less effective at clearing out mucus. That was a particular test, I think it was developed by Arthur D. Little.

Q. The filter additive had less of a negative impact on the cilia than the regular filter cigarettes?

A. On these rat or chicken cilia, whatever they were, as the test was performed, yes.

MR. HOFFMANN: Are we getting close to a point where we can take a break, John?

(A recess ensued.)

Q. (By Mr. Hoag) While we were on break, did you have any discussions with the attorneys regarding your testimony today?

A. Yes.

Q. What was the discussion?

A. They asked me what period of time I was referring to when I was talking about my experiences with Mr. Wiggand lying and cheating. I said that was during the time I was talking about when I was employed there.

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Q. Anything else?

A. No. I said I was going to wash my face, I am feeling sleepy.

Q. Before we took the break we were talking about an Arthur D. Little commissioned study, commissioned by, I guess, Brown & Williamson to look at the filter additive; and you said that the filter additive was less biologically active, the filter additive when placed into the filter made the tobacco smoke condensate less biologically active, right?

A. Made the tobacco smoke itself less biologically active. I think in the test the smoke was passed over a preparation of these cilia or whatever it was.

Q. It still was biologically active but less so, correct?

A. Correct.

Q. And what was that filter additive?

A. It was something that we called duolite, which was an iron exchange resin that would selectively filter certain aldehydes from cigarette smoke.

Q. Now, in order for Arthur D. Little to do this test they actually used rats; is that correct?

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A. As I said, I can't remember what the biological test proposal was. I don't think it was rats in this particular one. I think it was more like chicken cilia where you actually take a cilia out of a chicken some way or another and put it in sort of a glass apparatus and pass the smoke over it.

Q. And as a result of these tests, was any decision made about that filter additive?

A. Well, in that test it was less biologically active. It was just kind of a fact that is recorded.

Q. Well, that was in fact used in making a decision concerning whether or not to market that filter additive?

A. That fact was not part of the decision whether or not to market that filter additive. In fact, that filter additive was marketed in a cigarette called Fact; but the Fact cigarette was not commercially successful, nobody bought enough of them so eventually it was withdrawn from the market.

Q. And was Fact marketed as a safer cigarette?

A. No.

Q. How was it marketed, if you know?

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A. Well, it was marketed twice. First time I think the emphasis was this was a low gas cigarette, that didn't appear to work. And then the next time the marketing said this cigarette has less -- something along these lines -- less acetaldehyde and crotonaldehyde and consumers didn't find that very exciting, either.

Q. This test was done by Arthur D. Little. Did they use commercial cigarettes and just change the filter on commercial filters?

A. I don't remember. If we need to dig out the record we could. I don't remember if we used the Kentucky reference cigarette and compared that with and without a filter or whether we used it with our brands, I just don't know.

Q. Most of the time when these tests for biological activity was done, they used Kentucky reference cigarettes, correct?

A. Many did, yeah. But I just don't know whether this one did or not.

Q. But most of the time that was what was used, correct?

A. Well, I hate to be definitive, much of the time, but I don't know.

Q. But the Kentucky reference cigarette

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doesn't have any additives, correct?

A. I don't think that is so. Again, it is a matter of record what is in it but it would certainly contain some of the typical additives like sugar and glycerine and propylene glycol. It may not have any flavors added. Again, I don't know but it is a matter of record.

Q. But the Kentucky reference cigarette, to be more specific, doesn't contain any flavorings, correct?

A. I don't think it does, but again it is a matter of record, you could check.

Q. The flavorings comprise the majority of additives in the cigarettes, correct?

A. No. The minority, on a mass basis.

Q. Other than the flavorings, what are the other types of additives in the cigarettes?

A. We mentioned glycerine, propylene glycol, sugar, quite often some cocoa or chocolate and some licorice.

Q. Cocoa and the chocolate and licorice aren't flavorings?

A. Well, I guess they are but they are added in larger amounts than, say, the peach flavor or the strawberry flavor. They would be added in sort of

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tenths of a percent whereas the strawberry and the peach flavors are added in parts per million.

Q. Are you sure that arsenic isn't an additive that is used in cigarettes?

A. Yeah, I am positive.

Q. Are you sure that formaldehyde is not an additive that has been used in cigarettes?

A. You know, formaldehyde may have been part of some commercial flavorings mixture. Not to my knowledge so there I give a qualified sure.

Q. What other contracts are you aware of that Brown & Williamson had with Arthur D. Little to do tests on cigarettes concerning biological activity?

A. That's the only one I can think of off the top of my head, or even on reflection I can't think of another one which is not to say there weren't; but that's all I can recollect.

Q. Have you reviewed any of depositions taken in this Engle case?

A. No.

MR. HOAG: Turning to the leaf blenders manual, I would like to get that marked as Plaintiff's Exhibit 2.

MR. HOFFMANN: This exhibit will be

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under seal. Right now we didn't make a copy, we pulled it off one of our files. We will make a copy of it to be included in the deposition under seal but you can certainly identify it as Exhibit No. 2 for purposes of the deposition.

MR. HOAG: It is also Engle Plaintiff's Exhibit No. 1677 for purposes of trial.

MR. HOFFMANN: Also, the court reporter will be instructed that from this point forward until we tell her to the contrary that the deposition itself will be under seal.

MR. HOAG: The entire deposition, I don't agree.

MR. HOFFMANN: From this point forward, the portions of the deposition beginning now until we tell her to the contrary, will be under seal.

MR. HOAG: Okay. So long as I agree when we end that point. At least during the root technology and for leaf blenders discussion right now, I will agree to that.

(Begin confidential excerpt.)

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IN THE CIRCUIT COURT
OF THE ELEVENTH JUDICIAL CIRCUIT
IN AND FOR DADE COUNTY, FLORIDA
GENERAL JURISDICTION DIVISION

HOWARD A. ENGLE, M.D., et al.,

Plaintiffs,

vs. CASE NO. 94-08273CA20

R.J. REYNOLDS TOBACCO COMPANY, ETC., et al.,

Defendants.

CONFIDENTIAL EXCERPT OF THE

DEPOSITION OF

LANCE REYNOLDS

December 9, 1997

191 Peachtree Street
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(Begin confidential excerpt.)

(Plaintiff's Exhibit 2 was marked for identification.)

Q. (By Mr. Hoag) Plaintiff's Exhibit 2, the date on that is February 1, 1991, correct?

A. Yes.

Q. That says prepared by and names several people. Let's go through them. P.L. Aulbach, do you know that person?

A. Yes

Q. Who is that?

A. He was a chemist who worked in product development at Brown & Williamson.

Q. And did he have a master's or Ph.D. in chemistry?

A. Ph.D.

Q. Do you know what school he went to?

A. University of Louisville.

Q. How long did he work for Brown & Williamson?

A. Somewhere between 25 and 30 years.

Q. Was he a good chemist?

A. Basically yes, as far as I know.

Q. Did you ever supervise him?

A. Yes.

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Q. How would you characterize the quality of his work?

A. He was, when I supervised him, he was involved in international product development, more of a coordinating role in working with international people in our development of brands for sale overseas and he performed that work capably.

Q. Did you evaluate him?

A. I can't remember whether I ever specifically prepared a performance evaluation on him or not.

Q. How about R.R. Black, do you know that person?

A. Yes.

Q. Who is that?

A. Roger Black, who is a leaf blender. His degree, I think, is from NC State, possibly a master's degree in -- I hesitate to be too specific here, but something related to agricultural chemistry. Probably did his master's degree on some form of tobacco agriculture.

MR. HOFFMANN: The question was who is R.R. Black. I believe that was the question.

THE WITNESS: Well, he is --

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Q. (By Mr. Hoag) I would have asked you those other questions about his background so you were saving me a little time, really.

Is he still employed by the company?

A. Yes.

Q. How long has he worked there?

A. Probably about 15 years. I mean, it may be a bit more than that, but it is that sort of order.

Q. Did you ever supervise him?

A. Not directly. I might have supervised his supervisor if you see what I mean.

Q. Who was his supervisor at that time?

A. P.R. Fisher.

Q. What was P.R. Fisher's position at that time?

A. Manager of leaf blending and agriculture.

Q. And what time frame are we talking about?

A. This would be in the mid '80s.

Q. What was your position at that time?

A. Director of product development.

Q. What are the duties of a leaf blender?

A. Basically about three-fold, to evaluate tobaccos which Brown & Williamson may buy to ensure their quality and they are the type suitable to go

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into our cigarettes, to work with other people in the organization to ensure that we have sufficient stocks of the various grades of tobacco that we used to manufacture our cigarettes, and thirdly if we are developing new or improved products to determine the amounts of various types of tobaccos to go in those cigarettes.

Q. And who is, if you know, B.B. Chakroborty?

A. Chakraborty is a scientist employed at Brown & Williamson, I guess for the last 20 odd years or so, possibly more.

Q. What is his position?

A. His job title is something like either master scientist or principal scientist.

Q. What is his degree?

A. He has a Ph.D., in what I don't remember, because I think it was from a British university, whether it is in chemistry or chemical engineering, but I think chemistry.

Q. Did you ever supervise him?

A. Again, not directly but probably through somebody else.

Q. Are you familiar with the quality of his work?

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A. Yes.

Q. How would you characterize that?

A. Overall, a very good scientist, although like anybody, there are times when he has been in error.

Q. Have there been times when you have been in error?

A. Yes.

Q. What are those times that you can recollect?

A. Well, one that I can recollect -- and you will understand why I say I can recollect it when I tell you -- it was looking for a way of cost savings and I told Mr. Sandifer I thought we could save $12 million a year on menthol, in fact I was wrong by a factor of 10 in arithmetic, it was only 1.2 million. It wasn't so big a deal as I was making out.

Q. Anything else where you were in error that you can think of?

A. I think I had a very imperfect understanding of the role of smoke pH and nicotine absorption for a number of years. In that area, too.

Q. What years did you have a

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misunderstanding?

A. I don't think I ever really thought about it in great detail. I didn't think about it very much until some of these allegations came up in connection with the Food & Drug Administration proposing that they regulate cigarettes.

Q. So up until that time you were in error about your scientific understanding of pH and nicotine absorption?

A. Yes. Sloppy thinking.

Q. So up until that time did you come closer to agreeing with what later became the Food & Drug Administration position?

A. Sorry, say that again.

Q. Up until that time -- well, scratch that, withdraw that question.

A.C. Diesing, who was that, if you know?

A. He was a chemist employed at Brown & Williamson. He was the secretary of the additive guidance committee or panel or whatever it is called.

Q. Did he have a Ph.D.?

A. No.

Q. What was his educational background?

A. I don't recollect. I think he was a

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degreed chemist but from where and at what -- not a Ph.D. but beyond that, I can't tell you.

Q. And how long did he work for the company?

A. Probably 15 or 20 years.

Q. Does he still work there?

A. Pardon?

Q. Does he still work there?

A. No. He is retired.

Q. What year did he retire?

A. I think about '93.

Q. Did you ever supervise him?

A. Again, not directly but through other people.

Q. Are you familiar with the quality of his work?

A. Yes.

Q. How would you characterize his work?

A. He was very thorough. His job was, as I said, to maintain all the records of the additives, the amounts used and so forth; and he did that very capably and thoroughly.

Q. How long was he the secretary of the additives council?

A. Additives guidance panel.

Q. Guidance panel, I am sorry.

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A. I think from, I am going to say a period in the early '80s until he retired, may have been as long as ten years.

Q. What were his duties as the secretary of the additive guidance panel?

A. It was his job to have a full and complete record of all the additives that were used in various brands, purchased from various suppliers, and to maintain records of any toxicological evaluation we may have requested. He kept track of all of the paperwork concerning our use of additives.

Q. And where is that paperwork kept?

A. In Brown & Williamson R&D. I can't be more specific than that.

Q. What state is that in?

A. Well, I don't understand the question.

Q. Is that in a particular state in the United States?

A. Oh, Brown & Williamson R&D is in Macon, Georgia.

Q. How long are these documents concerning the additives kept, how long are they retained, if you know?

A. Well, I suspect forever.

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Q. What leads you to that conclusion, forever?

A. That I don't think, you know, part of our operational procedure, I am not quite sure how far you can go back, you can go back a long way in time so we could get the complete record of everything we made and what went into everything we made.

Q. So he kept the records of which additives were in each particular brand of cigarette?

A. Yes.

Q. And how much of each additive was in each cigarette?

A. Yes.

Q. R.A. Conterman, do you know who that is?

A. Yes. He is a chemist working in product development and as far as I know he is still there, probably been there 20 odd years.

Q. What is his educational background?

A. I think B.S. in chemistry, but I am not sure what university.

Q. What were his duties?

A. A product developer, so he would be responsible for the selection of cigarette papers, cigarette filter, flavorings for a new or improved or changed version of a cigarette brand.

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Q. And did you ever supervise him?
A. Again, not directly, but at the second level, yeah.
Q. How would you characterize the quality of his work?
A. Capable at product development.
Q. Do you know anything else about his skills and ability other than that?
A. No.
Q. How about R.R. Johnson?
A. He had a Ph.D. in chemistry, I think from Rice University. He was employed by Brown & Williamson before I was, probably in about -- may have been somewhere around 1960 or 1959 and he retired about the same time as I did.
Q. What was his title?
A. I think senior research scientist when he retired.
Q. Did you ever supervise him?
A. Yes.
Q. What was the quality of his work?
A. Variable. Some really good stuff and then some stuff where he was wrong or in error.
Q. When you evaluated him, did you give him a good evaluation, mediocre or bad, how would you

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characterize it?

A. Well, very variable performer. Some years he got very good evaluations, other years he didn't get very good evaluations. He was a free spirit.

Q. How about D.L. Scholten?

A. Chemical engineer by training, I don't know which university. Worked there, now at least probably about 20 years, I can't remember when he came, though.

Q. Chemical engineering degree and you are not sure whether it was a bachelor's or master's or Ph.D.

A. It wasn't a Ph.D. I am not sure if it was master's or bachelor's or from which school.

Q. Did you ever supervise him?

A. Again, not directly but a second level, yeah.

Q. What was his title at Brown & Williamson?

A. Well, he had various jobs over the years. At the time he was working on this, I think -- and I am not quite sure -- that he was working in product development, so doing very similar things to Gonterman but for international brands as opposed to domestic brands, I think.

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Q. What was the quality of his work?
A. Overall, capable.
Q. Now, have you had any opportunity to discuss this leaf blenders manual with any of these people?
A. You mean Aulbach, Black, Chakraborty, Diesing, Gonterman, Johnson, Scholten?
Q. Yes. Yeah, that's who I mean.
A. Only briefly with Chakraborty.
Q. How long ago was that?
A. I think when I was in Macon in February of this year.
Q. When was this, if you know? When did you first become aware that this handbook had been made public information through release, for example, on the Internet and in other places?
A. I think I first had an awareness when there was an article in the Wall Street Journal.
Q. When was that?
A. I don't know which year that was.
Q. That was way before February of this year, though, right?
A. Yeah.
Q. And you are aware this leaf blenders manual has been used and/or listed is an exhibit in

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litigation against Brown & Williamson, correct?

A. It certainly has today. What I am trying to recollect is if it was an exhibit in any of the other depositions I have been in. I can't remember off the top of my head right now, but I believe it was in Minnesota.

Q. Have you read the Engle complaint, the Engle lawsuit?

A. No.

Q. Do you know what the Engle case is about?

A. My understanding is is that it is a class action lawsuit brought on behalf of smokers in the state of Florida against, I guess, the tobacco companies that do business in Florida; and Engle is the name of one of the, whatever you call it, the named plaintiffs in the suit.

MR. HOFFMANN: John, are we done with the leaf blenders manual?

MR. HOAG: Probably not.

MR. HOFFMANN: Did you say probably not?

MR. HOAG: Yeah. I probably have a few more questions about it.

MR. HOFFMANN: Well, I guess in all fairness, since you have gone on another line

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of questioning, that these questions will not be under seal and we will tell you again when you go back under seal.

What is your estimated completion time now, since it is right at 4:30?

MR. HOAG: I don't think I am going to take more than 15 minutes.

MR. HOFFMANN: We have a court reporter with a child care problem and if you are, we may need to get someone else in.

MR. HOAG: I will do my best to achieve this schedule that I anticipated earlier.

MR. HOFFMANN: Okay.

(Discussion ensued off the record.)

(End confidential excerpt.)

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Q. (By Mr. Hoag) You are aware that people in the Engle complaint are claiming, are all claiming that they are addicted to nicotine, correct, you are aware of that?

A. I was told yesterday that this was a class action lawsuit, say, for and on behalf of smokers in the state of Florida. It was a bit unclear to me, I can remember something being said about nicotine addiction but I can't remember precisely what it is. I haven't seen the actual written complaint.

Q. When did you first become aware of allegations that the tobacco industry manipulated the nicotine levels of cigarettes?

A. It is one of two things. I am not quite sure which it is, whether it is -- because I can't remember the genesis of this FDA proposal, but they do this or whether it was an article in the Wall Street Journal. I am not sure.

Q. Approximately what year was it?

A. Well, I think either '93 or '94, I am supposing.

Q. In your estimation, it was at least two or three years ago you became aware of the allegation of nicotine manipulation by the tobacco

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industry, correct?

A. It was at least two years ago because it was two years ago that I was working with some of the people at Brown & Williamson on preparing a response to the Federal Trade Commission proposal. So let's say roughly 2-1/2 years ago.

Q. And what Federal Trade Commission --

A. I am sorry, I mean the Food & Drug Administration, FDA not FTC.

Q. What FDA proposal are you talking about?

A. Well, the proposal that basically the FDA would regulate cigarettes because in their view a cigarette was a drug delivery device and nicotine was a drug. Those were the sum and substance of how it was put across.

Q. And when were you first contacted to respond to that proposal?

A. I think in the -- let's back up. It is '97 now, must have been the fall of '95.

Q. And how were you compensated for that work?

A. Well, I had a consulting agreement with Brown & Williamson at that time and this fell within the sort of normal consulting agreement I had with them which at that time was 30 days a year, $30,000

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a year, a thousand dollars a day for any extra days.

Q. You spend more than 30 days that year?

A. I may have done, I may have been up to 40. But I don't have a specific recollection.

Q. And who contacted you about responding to the FDA proposal?

A. I don't specifically remember who.

Q. What were you asked to do specifically in order to prepare your response?

A. Well, there is a scientist at Brown & Williamson, Dr. Scott Appleton, who was preparing the technical writings for our response and I was helping him.

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(Begin confidential excerpt.)

Q. (By Mr. Hoag) Now, was the leaf blenders manual useful in responding to the FDA proposal?

MR. HOFFMANN: That question and answer will be under seal, please.

THE WITNESS: I think the leaf blenders manual had been used by the FDA in an attempt to support their position. There are various erroneous statements in the leaf blenders manual which the FDA were using. I can hardly say it was useful but we needed to respond and correct some of the inaccuracies that have been in the leaf blenders manual.

Q. (By Mr. Hoag) It was necessary to do that in order to respond to the FDA's proposal in a manner that was acceptable to the corporation, correct?

A. It was necessary to do that to set the record straight and provide science that was correct to the best of our knowledge in our response to the Food & Drug Administration.

Q. Prior to the FDA proposal, had anybody made any effort to revise the leaf blenders handbook?

A. As far as I know, no one was reading it.

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Q. Who was the leaf blenders manual distributed to?

A. As I understand it, to the CEOs of the British American Tobacco, of the Brazilian BATCO and the German BATCO and one or two other people; but the distribution was, as I understand it, handled by Mr. Pritchard and Mr. Wiggand. So I don't know who got copies and who didn't.

Q. Who is Mr. Pritchard?

A. He was the chairman of Brown & Williamson at the time.

Q. How did you come to understand that the distribution was handled by Mr. Wiggand and Mr. Pritchard?

A. Because some of the people at Brown & Williamson who might be expected to have a copy of it such as Mr. Reel who is now the vice president of R&D, or Mr. McMurtry, the director of product development, did not have copies of it and they said we don't know who has copies, it was handled by Mr. Pritchard and Mr. Wiggand.

Q. Whose idea was it to develop a leaf blenders manual or handbook for leaf blenders in product development?

A. I am not sure. We had done a bit of

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development work in the area of this and it was our practice from time to time to collect information and put it together anyway. I am not sure who said let's do this. I don't know.

Q. You said the only conversation you had with any of the authors of this exhibit handbook for leaf blenders was Chakraborty and that was in February of this year.

A. Yes.

Q. How did you come to talk to him about this?

A. Well, I think it was a conversation more or less along the lines of, Baron, we had some wrong stuff in there, didn't we. He said, yes, we did.

Q. That was it, you just said wrong stuff, he said yes, there was no more content in that conversation?

A. Yeah.

Q. Did you tell him what the wrong stuff was?

A. Well, I think he knew as well as I did.

Q. Was it wrong because the FDA was using it in order to regulate nicotine as a drug?

A. No. I would need to go through this page by page, which we don't have to do, so just bear

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with me. There was some wrong, loose language of the type we talked about in this Plaintiff's Exhibit 1, Page 2, Paragraph 2, if that was incorrect, then I am not sure if there was any incorrect full data in it or not.

Q. Let's refer to the introduction, first of all, Page 2, of the leaf blenders handbook, What Ammonia Does.

A. Okay.

Q. Second paragraph, second line, second sentence, in that line, It can liberate free nicotine from the blend which is associated with increases in impact and satisfaction reported by smokers. Do you agree or disagree with that statement?

A. I disagree with it.

Q. But you will agree in February of 1991 these seven authors of this document did agree with that statement, correct?

MR. HOFFMANN: Object to the form.

THE WITNESS: Well, I don't know that the seven authors all agreed to it, that's because each author would have probably concentrated on the portion which he -- yeah, no shes -- which he wrote. So I wouldn't

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agree that the seven authors, whoever penned it thought that.

Q. (By Mr. Hoag) Are you aware of whether any of them disagreed with that, what was in that introduction, at the time this was prepared in February of 1991?

A. No. I am not aware any of them disagreed with it.

Q. If any of them did disagree with it at that time, was it their job to state the disagreement at that time?

A. It would have been. Some of them might not have had the technical knowledge to disagree with that particular statement. As I say, it was loose, sloppy thinking which, I mean, I don't know whether I read this particular paragraph or not. I was certainly employed in February of 1991, if I read it at the time, I let it pass. That doesn't mean to say I agreed with it, it just meant I hadn't thought about it.

Q. Well, if any of those authors knew that the FDA was going to try to regulate nicotine as a drug, they certainly wouldn't have put it in the introduction, right?

MR. HOFFMANN: Object to the form of

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the question.

THE WITNESS: No. I disagree with you there.

Q. (By Mr. Hoag) Go ahead.

A. If this was a fact, if it was true, it is there. It is not true and it is still there. It doesn't make it right.

People don't write reports -- Brown & Williamson's R&D department wrote reports from the best of its capabilities from the science as they thought it at the time. It may have been erroneous but the reports weren't being written with the thought the FDA was going to regulate us. The report was written on what our understanding of science was, whether correct or incorrect, at that time.

Q. So has there been additional research regarding the effect or lack of effect on ammonia that would in any way change the results of this that was published in February of 1991?

MR. HOFFMANN: Object to the form of the question.

THE WITNESS: Are you talking about the total document or are you talking about this particular sentence?

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Q. (By Mr. Hoag) Right now I am talking about what is in that sentence that we just read in the introduction.

A. Well, I think even the research we had in hand at the time if we had looked at it would have said this is incorrect.

Q. Well, the research that we went over in Plaintiff's Exhibit 1 basically corroborates what is in that statement in the introduction to Plaintiff's Exhibit 2, correct?

A. No. The research that we went over in Plaintiff's Exhibit 1 --

Q. Which is the Pankow article, right?

A. Right. Here they were looking at the effect of passing air enriched with ammonia over smoke condensate deposited on a filter. In that particular experiment, nicotine released from the filter was enhanced but that's not by nowhere near the same situation with cigarette smoke where you have a great cloud of carbon dioxide which effectively keeps everything acidic. There was a heck of a lot more carbon dioxide in smoke than ammonia. If you look at the total smoke, it is a very acidic environment.

Q. So the conclusions in Plaintiff's Exhibit

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1, are those conclusions consistent with the conclusions regarding the effect of ammonia found in the handbook for leaf blenders and product developers which is Plaintiff's Exhibit 2 for purposes of this deposition?

A. I am sorry, Plaintiff's Exhibit 1 is a fairly dense 11 page article. What conclusions are you talking about?

Q. Under Page 8 of Plaintiff's Exhibit 1, Implications of these Findings, first sentence says, The addition of the ammonia to tobacco smoke particles has been found to greatly increase the volatility of nicotine from those particles.

Now, that sentence which is part of their findings is consistent with the introduction to the handbook for leaf blenders and product developers, correct?

A. Let me back up. This statement, the addition of ammonia to tobacco smoke particles, at least from my reading today and my recollection of their experiment was not what they did. They were passing ammonia vapors over tobacco smoke condensed on a filter. So I am not sure, you know, I am not sure that is actually a finding.

Q. Regardless of whether you agree with

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their finding, it is in fact what they labeled as a finding, correct?

A. They labeled that as a finding, but I cannot find this finding in their text.

MR. HOFFMANN: They label it as implication of a finding.

Q. (By Mr. Boag) Now, assuming that that sentence that I just read is in fact correct, is that sentence consistent with the introduction to the handbook for leaf blenders and product developers?

A. The handbook for leaf blenders and product developers erroneously states, It can liberate free nicotine from the blend which is associated with increases in impact and satisfaction reported by smokers. There's an erroneous statement in the leaf blenders handbook and as I say a finding which I can't find in Exhibit 1, the fact that two erroneous things are saying the same things, I agree with you they are both printed on these pieces of paper.

Q. Do they both pretty much say the same thing? I understand you disagree with it, but they both pretty much say the same thing, correct?

A. Well, one says smoke ammonia can liberate

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free nicotine from the blend, it is talking about the tobacco, the other is saying addition of ammonia to tobacco can increase the amount -- no, they are not saying the same thing. The leaf blenders handbook is talking about blend, that's tobacco, unburned; the Exhibit 1 is talking about tobacco smoke particles. No, they are not saying the same thing.

Q. Would you agree both the leaf blenders manual and Plaintiff's Exhibit 1 state that ammonia enhances the impact of nicotine?

A. Well, if we take the first two sentences of the leaf blenders handbook, first, the first and third sentences of the second paragraph, it says cigarette smoke ammonia is entirely different. It can liberate free nicotine from the blend which is associated with increased impact in satisfaction reported by smokers, those two are sentences from the leaf blenders handbook which I paraphrased or something or other in -- no, the thing on Page 2 is a different section.

I mean, it is saying much the same thing as it was saying on Page 1 but the fact that your Exhibit 1 contains a quotation from your Exhibit 2, apart from the fact that Exhibit 1 contains a

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quotation from Exhibit 2, I am not quite sure where that is leading.

MR. HOAG: I don't have any other questions. I appreciate your time and I hope everyone makes whatever connections they need to make.

MR. HOFFMANN: I am just going to ask a couple of questions on direct.

We can come out from under seal now.

(End confidential excerpt.)

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DIRECT EXAMINATION

BY MR. HOFFMANN:

Q. Mr. Reynolds, you said that nicotine affects the brain. Can you give some examples of any other substances that are typically ingested by human beings that affect the brain?

A. Caffeine has effects on the brain, alcohol certainly does, compounds in chocolates certainly do, caffeine of course is in tea, theobromine is the active ingredient in coffee. Most of the substances each of us eat and drink every day affect the brain.

Q. Are any of those substances you just mentioned classified as drugs?

A. I don't know how caffeine is classified. I assume it has got some drug classification but I don't know what.

Q. Now, tell us again, in what year did you leave Brown & Williamson?

A. In '91.

Q. And do you intend to testify at trial in this case about Brown & Williamson product development after you left in 1991?

A. Yes.

Q. And upon what factual basis do you have

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to provide such testimony?

A. Periodic visits to Brown & Williamson's research and development facilities, review of reports they prepare, yeah. Those kind of things.

Q. Is that done in your capacity as a consultant for Brown & Williamson?

A. Yes.

MR. HOFFMANN: That's all I have.

MR. HOAG: I have two questions.

RECROSS-EXAMINATION

BY MR. HOAG:

Q. Does cocaine affect the brain?

A. My understanding it does, yes.

Q. Does heroin affect the brain?

A. My understanding, yes.

Q. Do both cocaine and heroin effect an increase in the dopamine level in the brain?

A. I don't know the neurochemistry of what those two substances of abuse do.

MR. HOAG: I don't have any other questions. Is he going to read or waive?

MR. HOFFMANN: Read.

MR. HOAG: Bill, those two deposition exhibits are going to be attached to the deposition, one under seal until the judge

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rules.

MR. HOFFMANN: Correct.

(Deposition concluded 5:00 p.m.)

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Plaintiff's Exhibit	Description	Page
1	Conversion of Nicotine in Tobacco Smoke to Its Volatile and Available Free-Base Form through the Action of Gaseous Ammonia	72
2	A Handbook for Leaf Blenders and Product Developers (Confidential Exhibit)	162

(Original Exhibits 1 through 2 have been attached to the original transcript, Exhibit 2 having been filed separately in the sealed confidential excerpt.)

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STATE OF GEORGIA:
COUNTY OF FULTON:

I hereby certify that the foregoing transcript was reported, as stated in the caption, and the questions and answers thereto were reduced to typewriting under my direction; that the foregoing pages 1 through 195 represent a true, complete, and correct transcript of the evidence given upon said hearing, and I further certify that I am not of kin or counsel to the parties in the case; am not in the employ of counsel for any of said parties; nor am I in anywise interested in the result of said case.

Disclosure pursuant to O.C.G.A. 9-11-28(d):

The party taking this deposition will receive the original and one copy based on our standard and customary per page charges. Copies to other parties will be furnished at one half that per page rate. Incidental direct expenses of production may be added to either party where applicable.

Our customary appearance fee will be charged to the party taking this deposition

This, the 5th day of January, 1998.

Renda K. Cornick

Renda K. Cornick, CCR-B-909
My commission expires on the
26th day of November, 2000.

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DEPOSITION OF LANCE REYNOLDS/RKC

I do hereby certify that I have read all questions propounded to me and all answers given by me on the 9th day of December, 1997, taken before Renda K. Cornick, and that:

____ 1) There are no changes noted.
____ 2) The following changes are noted:

Pursuant to Rule 30(e) of the Federal Rules of Civil Procedure and/or the Official Code of Georgia Annotated 9-11-30(e), both of which read in part: Any changes in form or substance which you desire to make shall be entered upon the deposition...with a statement of the reasons given...for making them. Accordingly, to assist you in effecting corrections, please use the form below:

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_____

LANCE REYNOLDS

Sworn to and subscribed before me,
this the _____ day of _____, 1998.

_____

Notary Public

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Conversion of Nicotine in Tobacco Smoke to Its Volatile and Available Free-Base Form through the Action of Gaseous Ammonia

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Abstract

Ammonia-forming compounds are routinely added to cigarette tobacco. The U.S. Food and Drug Administration (FDA) has argued that this is done to promote the formation of the volatile free-base form of nicotine in mainstream smoke (MSS) particles, thus increasing its availability to the smoker. The presence of ammonia in tobacco smoke may also be expected to promote the volatilization of nicotine from environmental tobacco smoke (ETS) particles in indoor air. The gas/particle partitioning of nicotine can be parameterized in terms of the gas/particle partitioning constant $K_p = c_p/c_g$, where c_p (ng/μg) is the concentration in the particle phase and c_g (ng/m^3) is the concentration in the gas phase. The ability of ammonia to increase the amount of nicotine in the gas phase, as compared to the particle phase, was measured and confirmed. A gas-phase ammonia pressure of p_{NH3} of ~100 × 10^{-6} atm (100 ppmV) was found to reduce the K_p value for the partitioning of nicotine to tobacco smoke particulate matter by more than 100-fold. The agreement between ETS and MSS at $p_{NH3} \approx 100$ ppmV was excellent, suggesting that the overall physical properties (*e.g.*, polarity and number-average molecular weight) of ETS and MSS particulate material are very similar. Because gas-phase nicotine deposits more readily in the respiratory tract than does particle-phase nicotine and because free-base nicotine is more lipid soluble than is protonated nicotine, such a reduction in K_p will increase the availability of nicotine from MSS as well as from freshly formed ETS particles. At 20 • C and a relative humidity of 60%, the partitioning constant for the free-base form of nicotine is estimated to be $K_{p,fb} = c_{p,fb}/c_g = 10^{-4.94}$. Correction to a body temperature of 37 • C yields $K_{p,fb} = 10^{-5.97}$. Calculations using this $K_{p,fb}$ value indicate that about 25% of the nicotine will be in the gas phase at a temperature of 37 • C for inhaled MSS under the full ammonia effect at a total suspended smoke particulate matter level of 3 × 10^6 μg/m^3.

Introduction

The base ammonia, as well as ammonia-forming compounds such as diammonium phosphate (DAP) and urea, is routinely added to the tobacco used in domestic cigarettes (*1*-*4*). Though denied by the major domestic tobacco companies, the U.S. Food and Drug Administration (FDA) has argued that an intent of this use of ammonia is to increase as well as to control the delivery of the alkaloid nicotine to the respiratory tract of the smoker (*4*). The presumed mechanism underlying this

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proposed ammonia effect involves the formation, in the liquid tobacco smoke particles, of the volatile, free-base form of nicotine. In arguing their case that cigarettes are being manufactured as nicotine delivery devices, the FDA (4) has presented the following quote from one tobacco company's "leaf blender's manual":

"Ammonia, when added to a tobacco blend, reacts with the indigenous nicotine salts and liberates free [base] nicotine. As a result of such change, the ratio of extractable nicotine to bound nicotine in the smoke may be altered in favor of... [free-base] nicotine. As we know, extractable (i.e., free-base) nicotine contributes to impact in cigarette smoke, and this is how ammonia can act as an impact booster".

We also note that the conferees at a 1983 BATCO (British American Tobacco Co.) research conference in Rio de Janeiro agreed that in order to achieve the goal of "develop[ing] products that give improved smoker satisfaction", that it was important to know as much as possible about nicotine, including (4) "factors that affect the transfer of nicotine from leaf to smoke aerosol" as well as "factors that influence the rate of transfer of nicotine from particulate matter to the vapour phase".

Nicotine can exist in a diprotonated +2 form (Figure 1a), a monoprotonated +1 form (Figure 1b), and in the free-base form (Figure 1c). When protonated, the nitrogen on the pyridine (six-membered) ring (pK_1 = 3.12 at 20 °C) is considerably more acidic than the nitrogen on the pyrrolidine (five-membered) ring (pK_2 = 8.02 at 20 °C). From standard acid-base theory, the fraction of the nicotine that is in the free-base form (α_{fb}) is given by

$$\alpha_{fb} = \frac{1}{1 + 10^{-pH}/10^{-pK_1} + 10^{-2pH}/10^{-pK_1 - pK_2}} \quad (1)$$

Since pH values as low as ~3 are not expected in tobacco smoke particles, only the +1 and free-base forms are expected to be important in tobacco smoke. Under these conditions, eq 1 simplifies to

$$\alpha_{fb} = \frac{1}{1 + 10^{-pH}/10^{-pK_1}} \quad (2)$$

When $pH < pK_2$, the nicotine speciation is dominated by species other than the free-base form, and $\alpha_{fb} < 1.0$. On the other hand, raising the pH toward 8 (as for example through the action of a base such as ammonia) will drive α_{fb} toward 1.0 (5). An unverified assumption that underlies both eqs 1 and 2 is that no smoke-phase activity corrections are required for any of the nicotine species.

Figure 1. Forms of nicotine: (a) diprotonated, (b) monoprotonated, and (c) free-base.

In both mainstream tobacco smoke (MSS) and in environmental tobacco smoke (ETS = sidestream + exhaled mainstream smoke), the nonvolatile, protonated forms of nicotine can reside essentially only in the particle phase. (Nicotine salts possess very low volatilities.) However, the volatile free-base form can reside in the particle phase and can also partition into the gas phase. Increasing the proportion of the particle-phase nicotine that is in the free-base form will therefore tend to drive more nicotine into the gas phase. Fundamental principles of gas and particle deposition (6) predict that the conversion of nicotine to the volatile free-base form through the action of ammonia should thereby enhance the delivery of nicotine from inhaled smoke because (1) gas-phase nicotine diffuses more rapidly in air than does particle-phase nicotine and will therefore deposit more efficiently in the respiratory tract than will particle-phase nicotine and (2) nicotine that deposits from the gas phase will be depositing to lung tissue in molecular form and so will be able to begin diffusing into the body immediately. Furthermore, increasing the proportion of the particle-phase nicotine that is in the free-base form will increase the availability of the nicotine in those particles that deposit in the respiratory tract: free-base nicotine is much more lipid soluble than is protonated nicotine and will diffuse out of deposited particles and into adjacent tissue much more rapidly than will protonated nicotine.

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The effect of pH on the absorption of nicotine from inhaled aerosols of saline solution ammended with nicotine was investigated by Burch *et al.* (7). Those investigators found that increasing pH was associated with enhanced absorption of nicotine in the respiratory tract as measured by increased plasma concentrations of nicotine. That increasing pH and in particular the action of ammonia can increase the availability of nicotine from tobacco smoke has not, up to now, been demonstrated by any study conducted in the public domain. It is, however, consistent with the reported proper ties of tobacco smoke and nicotine. Particles of cigarette smoke have been found to be naturally acidic due to the presence among the pyrolysis products of many carboxylic and inorganic acids (8). Direct measurements of the pH of tobacco smoke particles made some years ago at unknown ammonia concentrations yielded values in the range 5.0-6.5 (9-11). pH is a relevant parameter in tobacco smoke particles because of the presence of a significant amount of water in these particles. Ambient ETS particles collected in a heavily contaminated indoor environment have been found to contain ~15% by weight water at a relative humidity (RH) value of 52% (5). In mainstream smoke and within the respiratory tract, RH values approaching 100% can be expected, causing yet higher levels of water in the particle phase.

The above view of the role of ammonia in tobacco smoke is analogous to what occurs when the alkaloid cocaine is "free-based" or used in "crack" form. Free-based cocaine and crack are typically prepared by reacting "street" cocaine (usually the HCl salt of cocaine) with aqueous ammonia and sodium bicarbonate, respectively (12). In both cases, the result is the more lipid-soluble, free-base form of cocaine, which is then smoked. Smoking volatilizes and aerosolizes the free-base cocaine which is rapidly absorbed into the body, leading to an immediate and intense high that is said to be comparable to that obtained with the intravenous injection of cocaine (12). In this paper, we demonstrate the ability of gaseous ammonia to increase the availability of nicotine from both mainstream and ETS particles. This was done by measuring the ability of particle-phase nicotine to leave that phase and enter the gas phase.

Gas/Particle Partitioning of Nicotine

A temperature- and humidity-dependent equilibrium partitioning constant $K_{p,fb}$ ($m^3/\mu g$) can be defined for the distribution of free-base nicotine between the gas and particle phases (5):

$$K_{p,fb} = c_{p,fb}/c_g \qquad (3)$$

where $c_{p,fb}$ ($ng/\mu g$) is the concentration of the free-base nicotine in the particle phase and c_g (ng/m^3) is the concentration of nicotine in the gas phase (assuming only the free-base form is volatile). If c_p ($ng/\mu g$) is the total (protonated + free-base) concentration of nicotine in the particle phase, then

$$K_{p,fb} = \alpha_{fb} c_p/c_g \qquad (4)$$

At a given temperature and RH, the value of $K_{p,fb}$ should be fairly independent of the specific type of tobacco that has been burned: a mixture of pyrolysis products (including some water) with more or less constant physical properties (except pH) can be expected. In the absence of direct information on the value of α_{fb}, the overall partitioning constant K_p can be measured where (5)

$$K_p = c_p/c_g = K_{p,fb}/\alpha_{fb} \qquad (5)$$

When the tobacco smoke particles are at acidic pH values so that $\alpha_{fb} \ll 1.0$, the protonation of nicotine reduces its tendency to volatilize to the gas phase, and K_p becomes large. Adding a base like ammonia to tobacco smoke will drive α_{fb} upward toward 1.0, thereby reducing K_p asymptotically toward $K_{p,fb}$, and increasing the volatilization and availability of the nicotine from the smoke particles. Thus, while $K_{p,fb}$ might be roughly constant at a given temperature and RH for different samples of tobacco smoke particles, K_p will be highly dependent on the distribution and acidities of the pyrolysis products found in the particles and on the amounts of bases like ammonia as well as nicotine itself that are available for reaction with those acids.

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A K_p value for nicotine of $10^{-2.83}$ $m^3/\mu g$ at 20 • C and 60% RH has been measured using ETS particles collected in a large hall very heavily contaminated with cigarette smoke (5). Given the relatively high pure compound vapor pressure exhibited by free-base nicotine [$10^{-1.48}$ Torr at 20 • C (13)], this measured K_p value is much higher than what would be expected for $K_{p,fb}$ for nicotine sorbing to such particles (5). This result was taken to suggest that (1) the value $K_p = 10^{-2.83}$ $m^3/\mu g$ was affected strongly by pH according to eq 5, (2) the addition of gas-phase ammonia to ETS would cause the measured K_p value to decrease markedly toward some $K_{p,fb}$ value as the gas-phase partial pressure p_{NH3} is increased, and (3) the presence of significant ammonia in mainstream smoke will depress nicotine's mainstream K_p toward that $K_{p,fb}$ value.

Experimental Section

ETS Measurements. ETS particles were collected on a precleaned 18.5 cm × 23.7 cm Teflon membrane filter (TMF) (2 μm pore size, Gelman Sciences) using a standard "hi-vol" air sampler. Air sampling took place in a large public hall that was heavily contaminated with tobacco smoke. This was the same site used previously (5). The average air temperature and RH during the sampling for this study were 16.2 • C and 62.8%, respectively. The flow rate was 1.35 m^3/min. The sampling time was 3 h, 35 min, for a total sample volume of 290 m^3. The filter was weighed, wrapped in aluminum foil, then placed in a −70 • C freezer, all within 1 h of sampling. The total suspended particulate (TSP) level for the sampling event was 420 $\mu g/m^3$, with the filter weighed at 48% RH. This is comparable to the TSP levels found by Benner *et al.* (14) in the Baltimore Harbor Tunnel, a major roadway tunnel (geometric mean TSP = 456 $\mu g/m^3$). We note here that the term RSP (respirable suspended particulate material) is more common in the tobacco smoke literature than is TSP. TSP ≈ RSP for the tobacco smoke particle size range.

The ETS particle load on the filter was 287 $\mu g/cm^2$; at the time of the analysis, the nicotine concentration c_p in the particles was 16 ng/μg and was determined as follows. A 47 mm diameter punch from the main filter was first spiked with 8000 ng of the surrogate standard nicotine-d_3, wetted with 0.5 mL of ethanol, then extracted 4 times for 2 min each time using 10 mL aliquots of water that had been acidified to pH = 0 with sulfuric acid. The extracts were combined, adjusted to pH >12 with concentrated NaOH, then back extracted 4 times with 10 mL aliquots of methylene chloride. After concentration to 0.5 mL and the addition of naphthalene-d_8 as an internal standard, the sample was analyzed by capillary column gas chromatography/mass spectrometry (GC/MS) using a DB-5 column.

All of the ETS nicotine desorption experiments were carried out within about 1 month of sampling. In each experiment, K_p was measured by determining the initial rate at which free-base nicotine was volatilized from the filter when clean, 20 • C, RH = 60% nitrogen gas at varying p_{NH3} levels was passed at ~1.5 L/min through the filter. The apparatus and experimental approach employed was similar to that used previously (5), except that valved flow (15-30 mL/min) from a bubbler in an NH_4OH solution (0-1.5 mol/L) was added as a variable source of NH_3 for the gas flowing over the ETS-loaded filter. For each run, two separate 47 mm diameter filter punches were taken from the 18.5 cm × 23.7 cm TMF. One was used to determine the total nicotine on the filter, the second was mounted in a 47 mm stainless steel filter holder, then exposed to the p_{NH3} level selected for that run. Adsorption losses of nicotine to the stainless surface in this system were checked, and found to be insignificant (<1%).

Three to four sequential measurements of the gas-phase nicotine concentration c_g in the flow leaving the filter were made over the course of each run, using sampling periods that ranged from 20 to 90 min. The total desorption flow through the filters ranged from 40 to 100 L. The approach used to

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analyze the data was the same as employed previously (5). For each run, the p_{NH3} level in the flow just upstream of the filter was measured using a 6 mm i.d. × 150 cm borosilicate glass "denuder" tube coated with oxalic acid. Approximately 25% of the total gas flow was passed through the denuder. After sampling, each denuder was extracted with 15-100 mL of NH_3-free water. Dissolved NH_3 was determined by the phenate method (15). The use of backup denuders revealed no significant breakthrough during sampling.

Gaseous nicotine was collected separately using the same type of oxalic acid-coated denuder tube employed for NH_3 collection. After sampling, each nicotine denuder was spiked with 4000 ng of nicotine-d_3, then extracted with 40 mL of water. Subsequent treatment and analysis of the 40 mL water extract proceeded as described above for the filter extracts. As in the ammonia determinations, the use of backup denuders revealed no significant breakthrough during sampling.

MSS Measurements. Several packs of two major brands of commercial cigarettes were purchased in Portland, Oregon. Each cigarette was individually numbered, weighed, and placed in a chamber with RH = 70% for at least 24 h before smoking. The two different brands were placed in separate chambers. Mainstream smoke was collected at room temperature (20-24 ° C) on 35.5 mm diameter, 2 μm pore size TMFs (Gelman Sciences, Ann Arbor, MI), using 2 s puffs of ~30 mL each and a puff rate of once every 30 s. Each cigarette was smoked until the combustion zone was ~0.5 cm from the cigarette filter. Under these conditions, 14-15 puffs were taken from each cigarette over 6.5-7.0 min. Each filter was weighed immediately after smoking, then stored at -70 ° C for less than 12 h. One cigarette was smoked per filter, yielding a particle load on the filter of ~10 mg, or ~0.1 mg/cm^2 (including water). The corresponding values for nicotine were ~0.55 mg and ~0.055 mg/cm^2. After removal from cold storage, each filter was allowed to return to room temperature, reweighed, then immediately loaded into the filter holder in the desorption apparatus described above. During desorption at 20 ° C, the nitrogen flow rate through the filter was ~1.5 L/min. The total desorption flow through the filters for the different runs ranged from 40 to 100 L.

After desorption, each filter was reweighed, then spiked with 10 000 ng of nicotine-d_3. To determine the remaining nicotine, each filter was then extracted in the same manner as with the ETS-loaded filters. This remaining amount was added to the cumulatively desorbed nicotine to calculate the initial mass of nicotine on each filter. All filter and denuder extracts were analyzed by GC/MS as described above.

QA/QC. Nicotine standards with concentrations of 2, 20, 40, and 100 ng/μL were run at the beginning of each series of nicotine analyses. Sample extracts were in every case within the range 4-20 ng/μL. Standards were also run during or at the end of each series of nicotine analyses. For each set of nicotine analyses, the standard deviation of the nicotine response factors for the different standard runs was always less than 10% and in most cases was in the range 4-7%. As noted above, nicotine-d_3 was used as a surrogate standard compound for nicotine. The absolute nicotine-d_3 recovery was checked for each nicotine analysis and found to be in the range 35-60%. The accuracy of the ammonia method was checked and found to be 20% relative to known standards. The precision for ammonia replicates was 6%.

Results and Discussion

Determination of $K_{p,fb}$. The log K_p vs p_{NH3} data for 20 ° C, RH = 60%, and RH = 90% are given in Table 1[S], and plotted in Figure 2. The ETS results for RH = 60% were found to be reproducible in a separate series of experiments using quartz fiber filters (QFFs). The log K_p values for both ETS and MSS undergo a dramatic drop as ammonia is added to the gas phase. As p_{NH3} rises to ~80 × 10^{-6} atm [80 parts per million by volume (ppmV)], log K_p begins to approach an asymptotic limit which we estimate as log $K_{p,fb}$ = -4.94 at 20 ° C. The measurements carried out at RH = 60% and 90% for

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MSS suggest that $K_{p,fb}$ does not depend strongly on RH.

Figure 2 Log K_p ($m^3/\mu g$) vs ammonia pressure p_{NH3} for environmental tobacco smoke (ETS) and mainstream tobacco smoke from two different brands of commercial cigarettes (MSS-A and MSS-B). At high p_{NH3} values, log K_p asymptotically approaches log $K_{p,fb}$.

The agreement between the ETS and MSS data at $p_{NH3} > 80$ ppmV is excellent. The fact that the MSS data lie below the ETS data for $p_{NH3} < 50$ ppmV may have been due to the presence of some residual ammonia in the MSS samples. Those MSS samples may therefore have been more in equilibrium with the lower p_{NH3} values (an so at a higher pH) than the ETS samples. At "high" p_{NH3} levels, any residual ammonia would have been unimportant compared to the applied p_{NH3}, leading to a convergence of the MSS data with the ETS data as observed here.

As discussed above, in the absence of added ammonia, a sample of ETS particles yielded $K_p = 10^{-2.83}$ (5). Since $10^{-4.94}/10^{-2.83} = 10^{-2.11}$, eq 5 implies that $\alpha_{fb} = 10^{-2.11}$ when log $K_p = -2.83$. By eq 2, this occurs when pH = 5.91, which would be consistent with the common view that cigarette smoke is naturally acidic. As p_{NH3} increases, the pH in the tobacco smoke particle phase will rise, driving $\alpha_{fb} \rightarrow 1$. For α_{fb} to reach 0.90, so that log $K_p \approx$ log $K_{p,fb}$ at 20-25 °C we require that pH $\approx$ 8.9.

Gaseous ammonia levels in mainstream tobacco smoke for contemporary commercial cigarettes have not been measured. However, according to the FDA (4), ammonia-containing additives like diammonium phosphate can comprise as much as 10% by weight of "reconstituted tobacco sheet" (RTS). Tobacco blends in cigarettes typically contain 20-30% RTS. These data indicate that ammonia-containing compounds can comprise as much as 2-3% of contemporary cigarette tobacco. Nicotine, of course, is also itself a base, and as such particle-phase nicotine will affect the particle-phase pH. The relative magnitudes of the relative roles of ammonia and nicotine in driving K_p toward $K_{p,fb}$ in contemporary commercial cigarettes are not presently known, though it seems likely that ammonia is very important.

K_p for Tobacco Smoke as a Function of Dilution. Liang and Pankow (5) reported a K_p value of $10^{-2.83}$ for ETS that was collected in a smoky indoor air environment (TSP = 455 $\mu g/m^3$) and returned to the laboratory for determination of K_p values by desorption. This ETS was probably exposed to the room air (including lab air after sampling) long enough to lose a significant amount of its original ammonia (and nicotine) by volatilization. Such a loss seems the likely explanation for why this value is so large compared to our estimate of $10^{-4.94}$ for $K_{p,fb}$. As noted above, this type of loss may also explain why for $p_{NH3} < 50$ ppmV the ETS data in Figure 2 plot above the MSS data. It is therefore of interest to examine K_p values which might be calculated for tobacco smoke from commercial cigarettes using actual gas- and particulate-phase nicotine values found in the literature, seeking evidence of loss of the pH-affecting compounds ammonia and nicotine as a function of smoke age and/or dilution.

Two studies with useful data are available, namely Caka *et al.* (16), who examined simulated ETS, and Lewis *et al.* (17), who examined MSS. Both of these studies used contemporary commercial cigarettes. For the Caka *et al.* (16) study, their "best" gas- and particle-phase concentrations were combined with their measured TSP values. For the Lewis *et al.* (17) study, their reported gas- and particle-phase fractions of 0.7 and 99.3% were combined with their reported TSP value of 1.7×10^7 $\mu g/m^3$. The resulting K_p values are presented in Table 2. As tobacco smoke becomes diluted and TSP falls, the value of p_{NH3} will decrease, causing K_p to rise. Figure 3 illustrates how this data

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would be consistent with this expected effect, and the resemblance to Figure 2 is striking. These results suggest that the c_p/c_g ratio for nicotine can be expected to change as concentrated tobacco smoke becomes diluted in indoor air.

Figure 3 Log K_p ($m^3/\mu g$) vs log TSP ($\mu g/m^3$) for environmental tobacco smoke (ETS) and mainstream tobacco smoke (MSS).

Percent Nicotine in the Gas Phase. The product c_pTSP gives the amount of particle-phase nicotine (protonated + free-base) in the smoke in units of nanograms per cubic meter. The percent P_g of the nicotine that is in the gas phase is then given by

$$P_g(\%) = \frac{c_g}{c_g + c_p TSP} 100\% \qquad (6)$$

When there is particle/gas *equilibrium* so that $c_p/c_g = K_p$, then

$$P_{g,eq}(\%) = \frac{1}{1 + K_p TSP} 100\% \qquad (7)$$

It is interesting to make some order of magnitude calculations with eq 7: TSP level in MSS is variable and depends on the presence or absence of a filter, the ventilation allowed by the wrapping and filter "tipping" papers, and other parameters (*18*). For filter cigarettes, a TSP level of ~4×10^7 $\mu g/m^3$ might be considered typical. This is based on data indicating that filter cigarettes yield ~12 mg of particulate matter (*18*), and assuming 8 35 mL puffs per cigarette. In the past, the study of inhaled tobacco smoke has involved a 35 mL puff followed by dilution into a single lung "tidal volume" of 500 mL (*19*). This yields a dilution factor of 14 and a TSP of 2.86×10^6 $\mu g/m^3$. Additional diffusive mixing at the front of the inhaled tobacco smoke can yield additional dilution (*e.g.*, say an additional factor of two for an overall dilution factor of 28). Table 3 gives the $P_{g,eq}$ values for a MSS value of 4×10^7 $\mu g/m^3$, this MSS value diluted by a factor of 14 (*i.e.*, MSS/14), and this MSS value diluted by a factor of 28 (*i.e.*, MSS/28). These TSP levels are combined with the 20 • C values of log K_p = -2.83 (small ammonia effect) and log K_p = -4.94 (full ammonia effect). The term small ammonia effect rather than no ammonia effect is used to refer to the log K_p = -2.83 value because even though no ammonia was added to the gas stream during that measurement, some residual ammonia from the original cigarette smoke may have remained in the smoke particle phase, thereby depressing the measured log K_p value below what would have been obtained for a truly zero ammonia system for that smoke material.

The calculations in Table 3 for equilibrium at 20 • C indicate that with the full ammonia effect acting on an MSS value for TSP of 4×10^7 $\mu g/m^3$, only ~0.2% of the mainstream nicotine will be in the gas phase. Measurements made on burning cigarettes indicate that MSS is in fact often close to ambient temperatures (*20*). As noted above, the ambient-temperature, commercial filter cigarette MSS measurements of Lewis *et al.* (*17*) at TSP = 1.7×10^7 $\mu g/m^3$ yielded a gas phase percentage of ~0.7% for nicotine. This is in very reasonable agreement with the ~0.5% that would be calculated for that TSP level and 20 • C and assuming the full ammonia effect.

The temperature of the human body is 37 • C. For partitioning to organic aerosols, it is known that K_p values are inversely proportional to vapor pressure (*21*). Since the vapor pressure of nicotine increases by a factor of ~10.8 between 20 and 37 • C (*22*), correction of the K_p values at 20-37 • C involves division by ~10.8. The nicotine fractions that are in the gas phase at equilibrium in MSS at 37 • C are calculated to be 0.018% and 2.3%, without and with the full ammonia effect, respectively. The potential for the absorption of gaseous nicotine from MSS in the oral cavity therefore seems small.

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In order to obtain upper bounds for the amounts of nicotine that can be in the gas phase, we will assume here that the nicotine starts to equilibrate before significant ammonia is lost (*i.e.*, in contrast to what is depicted in Figure 2, we will assume for the following calculations that K_p under the full ammonia effect does not decrease with TSP, at least not immediately). Under this assumption, the dilution of the MSS that accompanies a first-breath dilution factor of 14 increases the calculated equilibrium gas-phase fractions at 37 °C to 25% with the full ammonia effect and 0.25% without. For the former, the gas-phase fraction is now very significant, with the ammonia causing a boost to the gas-phase of 100-fold. Of course, nicotine at equilibrium in MSS will not reach its new equilibrium position for diluted, inhaled smoke instantaneously. However, the work of Lewis *et al.* (*18*) indicates that significant volatilization of nicotine can take place from MSS particles within time frames of a few seconds. These time frames are consistent with recent studies of the "off-gassing" of fluorene and phenanthrene from diesel soot particles observed by Kamens and Coe (*23*). Figure 4 provides plots for a range of TSP values.

Figure 4 Percent in gas phase at equilibrium (P_{eq}) vs log TSP ($\mu g/m^3$), *i.e.*, as a function of dilution. K_p values are assumed to hold constant with dilution. Key: MSS, TSP = 4×10^7 $\mu g/m^3$; MSS/14, TSP = 2.86×10^6 $\mu g/m^3$; MSS/28, TSP = 1.43×10^6 $\mu g/m^3$.

We note for the various TSP/temperature/ammonia combinations in Table 3 and Figure 4 that the values of P_{eq} given there might, at least under some circumstances, be underestimates of the fractions of the nicotine that could be delivered by gas deposition from smoke initially at particle/gas equilibrium. Indeed, deposition of gas-phase nicotine to the surfaces of the respiratory tract will lower the local nicotine gas-phase concentration. This disturbance of the particle/gas partitioning will draw more nicotine into the gas phase, and that nicotine will in turn be available for deposition from the gas phase. The process will continue until the remaining particles are exhaled. As noted above, experimental results obtained with MSS indicate that this volatilization can occur in seconds, with three times more nicotine capable of being drawn into the gas phase within 10 s than was initially present in that phase (*17*).

Implications of These Findings. The addition of ammonia to tobacco smoke particles has been found to greatly increase the volatility of nicotine from those particles. We interpret this result as being due to the conversion of nicotine from its protonated form to its free-base form. In particular, such an increase in the fraction of the particle-phase nicotine that is in the free-base form will increase the amount of nicotine that is in the highly available gas phase, and would also permit a more rapid absorption of free-base nicotine from particles that deposit in the respiratory tract.

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Table 1. Measured Values of Log K_p for Environmental Tobacco Smoke (ETS) Particles and Mainstream Smoke (MSS) Particles from Two Brands of Commercial Cigarettes (A and B) as a Function of p_{NH3} at 20 °C and two RH Values

$p_{NH3} \times 10^6$ (atm)	RH (%)	log K_p ($m^3/\mu g$)
ETS		
0	60	-2.83[a]
0.01	60	-3.00
1.7	60	-3.72
5.0	60	-3.77
21	60	-4.38
127	60	-4.93[b]
MSS-A		
0.0	60	-4.43
1.04	60	-4.43
18.6	60	-4.73
80.4	60	-4.88[b]
185	60	-4.95[b]
196	60	-4.90[b]
427	90	-4.99[b]
MSS-B		
140	60	-5.02[b]
296	90	-4.94[b]
average of high p_{NH3} values = log $K_{p,fb}$		-4.94

[a] This data point from Liang and Pankow (5) for ETS was obtained at the same ETS sampling site used in this study. [b] Log K_p values included in the estimate of log $K_{p,fb}$.

Table 2. Values of Log K_p for Tobacco Smoke Particles at Room Temperature as a Function of TSP[a]

TSP ($\mu g/m^3$)	log K_p ($m^3/\mu g$)
ETS, Cal[illegible] *et al.* (16)	
184	-3.76
190	-3.73
196	-3.79
930	-4.44
930	-4.46
990	-4.76
MSS, Lew[illegible] *et al.* (17)	
1.7 × 10[illegible]	-5.08

[a] Values calculated based on reported values of c_p, c_g, and TSP.

Table 3. Calculated Values of the Fraction $P_{g,eq}$ of Nicotine in the Gas Phase for *Equilibrium* Particle/Gas Equilibrium for Three Values of TSP (MSS, MSS/14, and MSS/28) and Two Values of Log K_p (Small Ammonia Effect and Full Ammonia Effect for Which $K_p = K_{p,fb}$)

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smoke type	TSP ($\mu g/m^3$)	ammonia effect	log K_p ($m^3/\mu g$)	percent in gas phase ($P_{g,eq}$%)
20 °C				
MSS	4.00×10^7	small	-2.83	0.0017
MSS/14	2.86×10^6	small	-2.83	0.024
MSS/28	1.43×10^6	small	-2.83	0.047
MSS	4.00×10^7	full	-4.94	0.22
MSS/14	2.86×10^6	full	-4.94	5.0
MSS/28	1.43×10^6	full	-4.94	5.7
37 °C				
MSS	4.00×10^7	small	-3.86	0.018
MSS/14	2.86×10^6	small	-3.86	0.25
MSS/28	1.43×10^6	small	-3.86	0.51
MSS	4.00×10^7	full	-5.97	2.3
MSS/14	2.86×10^6	full	-5.97	25
MSS/28	1.43×10^6	full	-5.97	40

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ROOT TECHNOLOGY

A HANDBOOK FOR
LEAF BLENDERS
AND PRODUCT DEVELOPERS

FEBRUARY 1991 RESTRICTED

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ROOT TECHNOLOGY

A HANDBOOK FOR
LEAF BLENDERS AND
PRODUCT DEVELOPERS

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FOREWORD

THIS HANDBOOK IS INTENDED AS A BASIC GUIDE FOR THE LEAF BLENDER AND/OR PRODUCT DEVELOPER WHO IS LOOKING FOR WAYS TO INCORPORATE ROOT TECHNOLOGY (RT) IN A CIGARETTE DESIGN. IT DOES NOT CONTAIN DETAILED CHEMICAL INFORMATION ON RT. RATHER, IT DESCRIBES WAYS TO

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USE THE TECHNOLOGIES THAT ARE CURRENTLY IN ROUTINE PRODUCTION USE. THE READER WHO USES THIS INFORMATION SHOULD CONSIDER THE GUIDELINES GIVEN AS A STARTING POINT, AND NOT AS FINAL PRODUCT SPECIFICATIONS. FOR ANY GIVEN PRODUCT THERE WILL BE AN OPTIMUM USAGE LEVEL AND APPLICATION SITE. WITH THE DIVERSE TYPES OF PRODUCTS AND VARIOUS CONSUMER TASTES IN MARKETS AROUND THE WORLD, THESE "OPTIMA" WILL ALMOST CERTAINLY BE DIFFERENT FOR VARIOUS PRODUCTS.

THE HANDBOOK IS CONSTRUCTED IN A WAY THAT GIVES THE READER A GENERAL BACKGROUND, GOES INTO EXPECTATIONS FOR THE RT's AVAILABLE, THEN DESCRIBES SPECIFIC APPLICATION INFORMATION. THE INTRODUCTION DESCRIBES THE BACKGROUND OF RT, INCLUDING COMPETITIVE ACTIVITY. THE NEXT SECTION BRIEFLY DESCRIBES THE

TYPES OF RT's WHICH ARE CURRENTLY AVAILABLE. SENSORY ATTRIBUTES GIVES MORE DETAIL ON HOW RT WORKS, AND DESCRIBES THE EFFECTS THE VARIOUS TYPES OF RT HAVE ON CIGARETTE SENSORY PROPERTIES. SPECIFIC APPLICATIONS DESCRIBES HOW A PRODUCT DEVELOPER AND/OR LEAF BLENDER SHOULD BEGIN PRODUCT DEVELOPMENT USING RT. THE FINAL TWO SECTIONS DEAL WITH REGULATIONS, RESTRICTIONS, AND CURRENT COMMENTS ON RT. A GLOSSARY IS APPENDED.

RT IS A RELATIVELY NEW TECHNOLOGY AT B&W AND WITHIN THE BAT GROUP OF COMPANIES. THERE IS A GREAT DEAL OF DEVELOPMENT WORK AND RESEARCH IN PROGRESS IN SEVERAL LABORATORIES. THUS, THIS HANDBOOK MUST BE VIEWED AS A FIRST EDITION, WITH LATER EDITIONS BEING PERIODICALLY ISSUED AS NEW KNOWLEDGE AND EXPERIENCE ARE GAINED.

AGAIN, THIS COMMUNICATION IS INTENDED TO GIVE THE BACKGROUND NECESSARY TO BEGIN PRODUCT DEVELOPMENT USING RT. AS SUCH, IT MUST BE SOMEWHAT GENERAL IN ITS NATURE. B&W R&D WILL DISCUSS ANY QUESTIONS IN FURTHER DETAIL ON REQUEST.

INTRODUCTION

WHAT AMMONIA DOES

AMMONIA IN TOBACCO REACTS WITH REDUCING SUGARS TO FORM NONVOLATILE FLAVOR PRECURSORS. THE FLAVORS ARE PRODUCED DURING SMOKING. THE DEGREE AND TYPE OF FLAVOR CHANGE IMPARTED BY AMMONIA/SUGAR PRODUCTS DEPENDS TO A LARGE DEGREE ON HOW STRONGLY THE AMMONIA AND SUGAR ARE FORCED TOGETHER. THERE IS A COMPLEX SEQUENCE OF REACTIONS THAT OCCUR, AND THE CLOSER ONE GETS TO THE ENDPOINT BEFORE MAKING CIGARETTES, THE BETTER THE TASTE (IN GENERAL). THE DETAILED CHEMISTRY IS LITTLE UNDERSTOOD, BUT IS SIMILAR TO THAT INVOLVED IN PRODUCTION OF AMMONIA CARAMELS.

CIGARETTE SMOKE AMMONIA IS ENTIRELY DIFFERENT. IT EFFECTIVELY SCAVENGES THOSE SMOKE COMPOUNDS THAT LEAD TO HARSHNESS. IT CAN LIBERATE FREE NICOTINE FROM THE BLEND, WHICH IS ASSOCIATED WITH INCREASES IN IMPACT AND "SATISFACTION" REPORTED BY SMOKERS. IT CAN ALSO DECREASE MENTHOL PERCEPTION FOR A GIVEN LEVEL OF APPLIED MENTHOL. THIS IS DESCRIBED IN GREATER DETAIL IN THE SENSORY ATTRIBUTES SECTION.

NATURAL AMMONIA REACTING WITH NATURAL SUGARS

THE IMPORTANT POINT IS THAT RT ALREADY OCCURS NATURALLY IN

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TOBACCO. IN PRACTICING IT WE ARE SIMPLY ENHANCING WHAT WAS THERE ALL THE TIME. TOBACCO CONTAINS NATURAL AMMONIA AND SUGARS, WHICH MUST CERTAINLY REACT. WE SEE SOME OF THE PRODUCTS NATURALLY IN FLUE-CURED TOBACCO.

AMMONIA/SUGAR EFFECTS ON SMOKE TASTE WERE ENHANCED WHEN CASED BURLEY TOBACCO WAS REDRIED IN MAKING PIPE TOBACCOS. CASING AND REDRYING GREATLY REDUCED THE HARSHNESS OF BURLEY, AND SLOWED ITS BURN RATE. THE BURLEY TASTE CHARACTER WAS ALSO CHANGED MARKEDLY. THIS APPROACH WAS LATER INCORPORATED IN THE DEVELOPMENT OF THE U.S. BLENDED CIGARETTE, WHICH FIRST APPEARED AS CAMEL IN 1913.

PHILIP MORRIS BAND-CAST RECONSTITUTED TOBACCO

RECONSTITUTED TOBACCO (RECON) MANUFACTURE WAS PIONEERED BY THE CIGAR MANUFACTURERS WHO NEEDED ECONOMIC ALTERNATIVES TO LEAF FOR BINDERS AND WRAPPERS. THE MOST SUCCESSFUL METHOD WAS DEVELOPED

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BY THE GENERAL CIGAR COMPANY. IT INVOLVED COOKING AND FINELY GRINDING A WATER SLURRY OF STEMS AND TOBACCO FINES, AND CASTING IT ON A WIDE STAINLESS STEEL BELT WHICH CONVEYED IT THROUGH A DRYING TUNNEL. THE DRIED SHEET WAS SCRAPED OFF THE END OF THE BELT. THIS IS THE BAND CAST PROCESS, SOMETIMES ALSO CALLED THE SLURRY PROCESS. SOME NATURAL PECTIN IS RELEASED DURING THE GRINDING AND COOKING OF THE SLURRY, AND IT IS THIS PECTIN THAT HOLDS THE FINAL RECON SHEET TOGETHER. B&W's RECON, PCL, WAS MADE IN THIS MANNER WITH NO FURTHER CHEMICAL TREATMENT OR ADDED BINDERS. IMASCO's AJAX PROCESS PCL IS MADE IN THE SAME WAY, BUT SOMETIMES WITH A BINDER, SODIUM CARBOXYMETHYLCELLULOSE.

AT ABOUT THE SAME TIME, IN THE EARLY 1950's, PHILIP MORRIS (PM) WAS ALSO DEVELOPING A BAND-CAST RECON TO REALIZE THE ECONOMICS OF FULLY USING STEMS AND TOBACCO FINES. BUT PM DECIDED TO FREE MOST OF THE PECTIN IN THE TOBACCO, THUS PRODUCING A STRONG SHEET. PECTIN RELEASE WAS ACCOMPLISHED BY COOKING THE SLURRY WITH DAP, AND ADDING MORE AMMONIA AS NECESSARY TO MAINTAIN EFFICIENT PECTIN RELEASING CONDITIONS. WE CALL THIS SHEET RCB.

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PM'S RCB SHEET DRAMATICALLY ALTERED THE SMOKE TASTE FROM TOBACCO BLENDS. THE TASTE CHARACTER SHIFTED STRONGLY TOWARD BURLEY. WAS THIS BY DESIGN OR BY ACCIDENT? WE DON'T KNOW FOR SURE, BUT IT IS A MAJOR PLAYER IN ESTABLISHING THE TASTE OF MARLBORO.

PM's PAPER RECON

A PAPER PROCESS RECON IS INHERENTLY CHEAPER TO MANUFACTURE THAN A BAND-CAST RECON. THIS IS BECAUSE THE FIBERS IN THE STARTING MATERIAL ARE USED AS THE BINDER. THUS, LESS REFINING IS NECESSARY, AND PROCESSING AND ENERGY COSTS ARE LOWER.

SMALL AMOUNTS OF PAPER RECON FIRST APPEARED IN PM'S BRANDS IN 1974. OVER A PERIOD OF SEVERAL YEARS IT INCREASED UNTIL IT LEVELLED OFF AT ABOUT 70% OF THE RECON IN PM'S CIGARETTE BLENDS. THIS GROWTH IN PM's PAPER RECON USAGE COINCIDED WITH THE EXPLOSIVE GROWTH OF THEIR MARLBORO BRAND.

AT SOME POINT, PM INTRODUCED RT INTO THEIR PAPER RECON PROCESS. THIS WAS DONE BY ADDING DAP TO THE MIX. THE IMPORTANT POINT IS THAT PM

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HAS NEVER BEEN ABLE TO FULLY REPLACE RCB WITH THEIR CHEAPER PAPER RECON. THIS FACT LED TO THE CONCLUSION AT B&W THAT RCB IS THE "SOUL OF MARLBORO". CONFIRMATION OF THIS CONCLUSION IS PROVIDED BY PM's USE OF RCB IN WORLDWIDE MARKETS, WHEREVER REGULATIONS AND ECONOMICS ALLOW, WHILE OTHER COMPONENTS DO VARY.

TWO RECENT CHANGES IN PM's PAPER RECON HAVE BEEN INCORPORATION OF UREA (MORE LATER) FOR HARSHNESS REDUCTION, AND THE USE OF PROPYL PARABEN TO RETARD MOLD GROWTH.

PM's AMMONIUM CARBONATE EXPANDED TOBACCO (ACET)

PM FIRST STARTED USING ACET IN THE EARLY 1970's. HOWEVER, THIS EXPANSION PROCESS HAS PROBLEMS, INCLUDING CORROSION OF PROCESS EQUIPMENT. ACET WAS PHASED OUT IN THE U.S. ABOUT DECEMBER, 1981. IN THE LAST PHASES OF ACET USE, ONLY PM's LOUISVILLE FACTORY WAS MAKING MARLBORO WITH ACET; THE RICHMOND AND NORTH CAROLINA FACTORIES WERE MAKING MARLBORO WITH DIET. IT IS OUR UNDERSTANDING THAT PM USED AMMONIUM CARBONATE IN CASINGS DURING THE TRANSITION STAGE WHILE ACET WAS BEING PHASED OUT.

PM IS ALSO USING AMMONIUM CARBONATE TO FACILITATE NICOTINE RELEASE IN DENICOTINIZING TOBACCO FOR THEIR NEW "DE-NIC" BRANDS. THESE ALL SEEM TO USE THE SAME 100% FLUE-CURED BLEND, BUT THIS BLEND ENDS UP WITH TWICE THE AMMONIA LEVEL OF THEIR MARLBORO BLEND.

B&W's UREA DEVELOPMENT

B&W OBTAINED A U.S. PATENT IN 1976 ON THE USE OF ADDED UREA TO MAKE A FLUE-CURED BLEND TASTE MORE LIKE A U.S. BLEND. UREA WAS ALSO FOUND TO BE VERY EFFECTIVE IN REDUCING AT LEAST ONE TYPE OF HARSHNESS, THE TYPE THAT ARISES FROM SMOLDERING CELLULOSICS. IN EARLY RT WORK ON A VERY HARSH BLEND, THE USE OF UREA WAS VERY EFFECTIVE. WHILE B&W DID NOT PURSUE THIS DEVELOPMENT FURTHER, CELANESE USED ABOUT 2% UREA IN THEIR CYTREL TOBACCO SUBSTITUTE TO REDUCE "PAPER TASTE". B&W WORK WITH SIMILAR TOBACCO SUBSTITUTES SHOWED UREA TO MARKEDLY IMPROVE THEIR SMOKE TASTE. KIMBERLY-CLARK HAS ALSO PROPOSED A MIX OF UREA AND PALMITIC ACID FOR REDUCING THE HARSHNESS OF PAPER RECONS.

B&W DEVELOPMENT OF CPCL

RT GENERALLY INVOLVES "FORCING SOME AMMONIA CHEMISTRY", AND THIS IS MOST CONVENIENTLY DONE DURING RECON MANUFACTURE. B&W's TWO RT RECONS WILL BE BRIEFLY DEFINED HERE, AND DETAILED IN LATER SECTIONS OF THE HANDBOOK.

THE OBJECTIVE IN CPCL DEVELOPMENT WAS TO MATCH PM's RCB IN ALL IMPORTANT CHARACTERISTICS EXCEPT FOR NITRATE REMOVAL. (PM REMOVES SOME NITRATE FROM RCB.) THIS OBJECTIVE HAS BEEN MET. THERE STILL REMAIN SOME LESSER DIFFERENCES, SUCH AS MORE LICORICE IN RCB.

WITH THE PURCHASE OF THE LANCASTER FACTORY FOR CPCL PRODUCTION, B&W WILL SOON BE IN A POSITION TO FURTHER OPTIMIZE THIS IMPORTANT RECON PRODUCT, INCLUDING NITRATE REMOVAL. THE FIRST STEP IS TO

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GET THE PROCESS OPERATING SMOOTHLY AND MEET B&W's QUALITY AND PRODUCTION REQUIREMENTS. PLANS ARE BEING FORMULATED FOR LATER OPTIMIZATION EXPERIMENTS.

AN IMPORTANT NOTE IS THAT USE OF OPCL ALLOWS THE USE OF LESS BURLEY IN THE BLEND. THIS IS BECAUSE

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OPCL SHIFTS SMOKE CHARACTER IN THE "BURLEY DIRECTION".

B&W DEVELOPMENT OF EBR

EBR DEVELOPMENT HAD THE TWOFOLD OBJECTIVES OF MAKING RT RECON AND REMOVING NITRATE. THE STEM SIDE OF THE FURNISH IS PRIMARILY BURLEY STEMS, WHICH CONTAIN A HIGH LEVEL OF NITRATE. THE EXTRACT FROM THE STEM DIGESTION IS DISCARDED, WHICH REMOVES 60-70% OF THE NITRATE FROM THE FINISHED PRODUCT. DAP AND REDUCING SUGARS ARE ADDED TO THE CONCENTRATED EXTRACT LIQUOR (CEL) FROM LAMINA FINES EXTRACTION. THIS CEL IS THEN ADDED BACK TO THE BASE PAPER WHICH IS FORMED FROM THE EXTRACTABLE FIBER RESIDUE.

AMMONIATED CASINGS

BATCF USE HIGH LEVELS OF STEM MADE BY A WATER TREATMENT PROCESS. DUE TO REGULATORY RESTRICTIONS ON OTHER RT's, BATCF DEVELOPED ENERGE AS A STEM CASING ADDITIVE. IT CONTAINS AMMONIUM SALTS OF ACIDS OCCURRING NATURALLY IN TOBACCO, WITH SOME NATURAL PLANT POLYSACCHARIDE GUM.

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BONZA CRUZEIRO USES HIGH TREATED STEM LEVELS AND NO RECON IN THEIR BLENDS. THEY HAVE DEVELOPED A TOBACCO CASING (ANSIRO) MADE BY HEATING AMMONIUM HYDROXIDE WITH A 70% ETHANOL EXTRACT OF BANANAS.

BAW USES DAP AS A CASING IN SOME LICENSED PRODUCTS. THIS IS IN ADDITION TO THE DAP IN THE EBR USED IN THIS BLEND. DAP WAS USED IN THESE PRODUCTS PRIOR TO USE OF EBR IN THE BLEND, AND REMAINED AFTER EBR WAS SUBSTITUTED FOR THE MOORGATE RECONSTITUTED TOBACCO (MRT). THIS HIGHER LEVEL OF DAP WAS SHOWN TO BE PREFERRED IN A CONSUMER PRODUCT TEST.

EACH OF THESE CASING MATERIALS IS DISCUSSED IN MORE DETAIL LATER IN THE HANDBOOK.

OTHER ROOT TECHNOLOGY IN THE U.S. MARKET

THERE ARE TWO CONSISTENT TRENDS APPARENT IN THE U.S. MARKET. FIRST, RECON IS THE PREFERRED MEANS FOR APPLYING RT. SECOND, EVERYONE IS WORKING HARD TO MATCH PM SMOKING QUALITY.

THE SITUATION AT B&W IS USE OF RT IN ALMOST ALL

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DOMESTIC AND EXPORT NONMENTHOL BRANDS. B&W IS ALSO DOING MAJOR DEVELOPMENT WORK ON VARIANTS OF EXISTING RT.

PM USES RT IN MOST, BUT NOT ALL, DOMESTIC BRANDS, BOTH MENTHOL AND NONMENTHOL. HOWEVER, PM's NEWEST MENTHOL BRANDS (ALPINE AND

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MARLBORO MENTHOL, DO NOT USE RT. RM's U.S. BLEND EXPORT PRODUCTS GENERALLY USE RT.

R.J. REYNOLDS USE RT IN SOME BRANDS, MOST NOTABLY WINSTON. THEY APPEAR TO DIRECTLY AMMONIATE THEIR PAPER RECON SHEET USING GASEOUS AMMONIA. BAND CAST RECON IS NOT USED IN ANY RJR PRODUCTS.

LORILLARD HAS BEEN USING DAP IN CASINGS FOR MANY YEARS. WE NOW FIND A CONSIDERABLE AMOUNT OF DAP IN THE RECON USED IN MANY LORILLARD BRANDS.

AMERICAN TOBACCO HAS BEEN USING A DAP RECON IN SOME OF THEIR NEW BRANDS.

WE HAVE NOT SEEN ANY SIGN OF RT IN LIGGETT'S BRANDS.

CHEMICAL SYNOPSIS OF ROOT TECHNOLOGIES

[illegible] BAT, THERE ARE BASICALLY FIVE SYSTEMS USED FOR DELIVERY OF RT INTO PRODUCTION. THESE ARE CPCL, EBR, DAP, BATCF'S EMERGE, AND SOUZA CRUZ'S ANSIED. THERE ARE OTHER RT's CURRENTLY IN DEVELOPMENT WORK, AND SOME OF THEM WILL BE MENTIONED AT THE END OF THIS SECTION. HOWEVER THIS HANDBOOK WILL CONCERN ITSELF ONLY WITH THE FIVE MENTIONED ABOVE. THE FOLLOWING IS A BRIEF DISCUSSION OF THESE RT's. THEY ARE DESCRIBED IN MORE DETAIL IN THE SENSORY ATTRIBUTES AND SPECIFIC APPLICATIONS SECTIONS.

CPCL

CPCL IS A BAND-CAST RECONSTITUTED TOBACCO, WITH 7.4% DAP, 3.1% AMMONIUM HYDROXIDE AND REDUCING SUGARS INCLUDED IN ITS FORMATION. IT IS THE FORM OF RT THAT HAS BEEN THE MOST SUCCESSFUL AT B&W TO IMPROVE SENSORY CHARACTERISTICS. ITS BENEFITS COME FROM BEING AN AMMONIA SOURCE, AS WELL AS INCORPORATING SUGAR-AMMONIA REACTIONS, AS A LOW ALKALOID BLEND COMPONENT, IT ALSO ABSORBS NICOTINE

FROM HIGHER ALKALOID-CONTAINING COMPONENTS. IT INCREASES BURLEY CHARACTER IN THE BLEND, WHILE REDUCING IRRITATION. THIS CAN ALLOW REDUCING THE PERCENTAGE OF BURLEY IN THE BLEND. IT IS DIFFERENT FROM MANY OTHER RECONSTITUTED TOBACCOS IN THAT IT IS A POSITIVE BLEND CONTRIBUTOR RATHER THAN MERELY A FILLER.

CPCL HAS A LOWER FILL VALUE THAN LEAF OR PROCESSED STEM. IT IS ALSO LESS "DURABLE" THAN LEAF, RESULTING IN A SMALLER PARTICLE SIZE DISTRIBUTION AFTER PROCESSING. FOR THESE REASONS, IT WILL IN ALL LIKELIHOOD BE NECESSARY TO INCREASE CIGARETTE DENSITY TO ACHIEVE EQUAL CIGARETTE PHYSICAL PROPERTIES WHEN REPLACING EITHER STEM OR LEAF WITH CPCL.

DUE TO ITS ALMOST "COMPLETE" AMMONIA CHEMISTRY, SUGAR-AMMONIA REACTIONS AND A SMOKE AMMONIA SOURCE, CPCL IS THE PREFERRED METHOD FOR INCORPORATING RT IN A BLEND. DUE TO ITS POTENCY, HOWEVER, CARE MUST BE TAKEN NOT TO OVERPOWER THE BLEND. THIS IS COVERED IN MORE DETAIL LATER IN THE HANDBOOK.

A CAUTION IS THAT CPCL MUST BE AGED THIRTY DAYS AFTER MANUFACTURE PRIOR TO PROCESSING. IN addition,

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FINISHED PRODUCT MUST AGE FOR AT LEAST ONE WEEK AND PREFERABLY TWO) BEFORE SMOKING.

EBR

EBR IS A PAPER-TYPE RECON, WITH 3% DAP AND REDUCING SUGARS INCLUDED IN ITS FURNISH. IT IS A SOURCE OF AMMONIA, AND SOME SUGAR-AMMONIA CHEMISTRY IS INVOLVED. IT IS EFFECTIVE AT REDUCING IRRITATION REPORTED BY SMOKERS, AND IMPARTS BURLEY CHARACTER. AS WITH CPCL, IT ABSORBS NICOTINE FROM OTHER BLEND COMPONENTS.

EBR'S FILL VALUE IS ALSO LOWER THAN THAT OF PROCESSED STEM OR LEAF. IT IS ALSO LESS DURABLE THAN LEAF, BUT MORE DURABLE THAN CPCL. THUS, IT WILL PROBABLY ALSO BE NECESSARY TO INCREASE CIGARETTE DENSITY TO ACHIEVE EQUAL CIGARETTE PHYSICAL PROPERTIES WHEN REPLACING LEAF OR STEM WITH EBR.

EBR CAN BE USED AT VIRTUALLY ANY LOGICAL RECONSTITUTED LEVEL IN THE BLEND WITHOUT DELETERIOUS EFFECTS FROM THE AMMONIA. IN FACT, IT CAN BE USED IN CONJUNCTION WITH CPCL TO ACHIEVE THE DESIRED SMOKE SENSORY PROPERTIES.

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DIAMMONIUM PHOSPHATE (DAP)

WHILE DAP IS USED IN THE RECONS MENTIONED ABOVE, IT CAN ALSO BE USED AS A CASING, AND BE APPLIED DIRECTLY TO THE BLEND. RT IS A WHITE CRYSTALLINE SUBSTANCE, EASILY DISSOLVED IN WATER. THE RESULTING SOLUTION IS SOMEWHAT CORROSIVE, HOWEVER, AND STAINLESS STEEL EQUIPMENT MUST BE USED TO HANDLE IT. IT ALSO DOES NOT MIX WELL WITH SOME OTHER CASING COMPONENTS, SOMETIMES CAUSING PRECIPITATION IN THE CASING KETTLE. THUS, IF USED AS A LEAF CASING, IT MUST BE HANDLED AND SPRAYED SEPARATELY FROM OTHER LEAF CASINGS. WHERE USED, DAP IS TYPICALLY APPLIED AT 0.5% OF THE TOTAL BLEND. HOWEVER, IT IS PREFERRED TO USE THE DAP IN THE FORM OF CPCL OR EBR. BY DOING THIS, THE SUGAR-AMMONIA CHEMISTRY WILL ALREADY BE IN PLACE, AND WILL NOT HAVE TO BE INITIATED WITH OTHER CASING COMPONENTS.

EMERGE

SINCE DAP (AND CONSEQUENTLY CPCL AND EBR) IS NOT ALLOWED BY GERMAN REGULATIONS, BATCF HAVE DEVELOPED EMERGE AS A PRIMARY SOURCE OF AMMONIA IN CIGARETTES.

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IT IS AN EASILY HANDLED WATER-BASED SOLUTION OF AMMONIA AND SEVERAL ACIDS. AS WITH OTHER RT'S, IT IS BEST APPLIED TO A LOW-ALKALOID PORTION OF THE BLEND, PREFERABLY STEM OR RECONSTITUTED TOBACCO. THE MECHANISM IS DIFFERENT FROM THAT OF CPCL AND ERR, AS EMERGE ACTS PRIMARILY AS A SOURCE OF AMMONIA WITH LESS OF THE SUGAR-AMMONIA REACTIONS ASSOCIATED WITH CPCL AND EBR.

EMERGE IS LESS CORROSIVE TO PROCESS EQUIPMENT AND IS EASIER TO HANDLE THAN DAP. IF APPLIED TO STEM, IT REDUCES THE STEM HARSHNESS. HOWEVER, IT CAN ALSO REDUCE THE FILL VALUE OF THE STEM, AND EXPERIMENTS TO DETERMINE AN APPROPRIATE DENSITY INCREASE ARE INDICATED.

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ANSIRO

ANSIRO IS A CASING WHICH CAN BE USED ON STEM OR LAMINA DEVELOPED BY SOUZA CRUZ WITH A SLIGHTLY DIFFERENT APPROACH. IT USES AMMONIA IN CONJUNCTION WITH A BANANA EXTRACT. THUS, IT INCLUDES SOME SUGAR-AMMONIA CHEMISTRY AS WELL AS BEING A SOURCE OF AMMONIA. IT IS A BROWN WATER-BASED LIQUID, WHICH IS

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EASILY HANDLED AND NON-CORROSIVE. SOUZA CRUZ'S EXPERIENCE IS THAT IT IS BEST TO APPLY ANSIRO PRIOR TO STEM EXPANSION. IF USED ON STEM, AS IT REDUCES THE FILLING VALUE OF THE STEM IF APPLIED AFTER EXPANSION. IF USED AS A CASING, IT SHOULD BE APPLIED TO THE FLUE-CURED TOBACCO RATHER THAN THE BURLEY IF THE BURLEY TOBACCO IS REDRIED.

ONE OBVIOUS DIFFERENCE BETWEEN ANSIRO AND THE EMERGE AND DAP RT's IS THE USE OF BANANA EXTRACT. ANSIRO WILL IMPART FLAVOR NOTES AS WELL AS THE NORMAL EFFECTS FROM RT. IT IS EFFECTIVE IN REDUCING IRRITATION, WITH SOMEWHAT LOWER CONTRIBUTION TO BURLEY CHARACTER THAN THE OTHER METHODS.

"ON THE HORIZON"

RESEARCH IS CONTINUING IN THE DEVELOPMENT OF OTHER RT's. THESE INCLUDE SUGAR-AMMONIA REACTION OF NEW TYPES, DEER, AND OTHERS. THE USE OF AMMONIUM TARTRATE WITH ANSIRO IS BEING INVESTIGATED BY SOUZA CRUZ WITH SOME SUCCESS. AT THIS POINT IN TIME, HOWEVER, THE RT's MENTIONED ABOVE ARE THE "TRIED AND TRUE" METHODS WHICH CAN BE IMPLEMENTED WITH ASSURANCE

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OF SUCCESS.

CONCLUSIONS AND RECOMMENDATIONS

THE PREFERRED METHOD FOR IMPLEMENTING RT IS THE INCLUSION OF CPCL IN THE BLEND. AN ALTERNATIVE APPROACH IS TO USE EBR, OR A COMBINATION OF CPCL AND EBR. THIS WOULD ALLOW A RECONSTITUTED TOBACCO INCLUSION OF OVER 10% IN THE BLEND.

IF RECONSTITUTED TOBACCO OR DAP ARE NOT APPROPRIATE, EMERGE AND ANSIRO ARE GOOD ALTERNATIVES TO USE. HOWEVER, KEEP IN MIND THAT THESE METHODS ARE NOT INTERCHANGEABLE. THE MECHANISMS ARE DIFFERENT, AND CAN HAVE VARYING INTERACTIONS WITH VARIOUS BLEND TYPES.

ONE ADDITIONAL CAUTION IS THAT PRODUCTS USING RT MUST BE ALLOWED TO AGE FOR AT LEAST ONE WEEK AFTER FABRICATION BEFORE BEGINNING SENSORY TESTING. THIS AGING IS TO ALLOW THE VARIOUS MECHANISMS ASSOCIATED WITH RT TIME TO OCCUR.

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SENSORY ATTRIBUTES

BEFORE DISCUSSING THE SENSORY ATTRIBUTES OF THE INDIVIDUAL VEHICLES FOR AMMONIA INCORPORATION, IT IS IMPORTANT TO UNDERSTAND THE SCOPE OF RT IN MODULATING A PRODUCT. IMPORTANT FUNCTIONS OF AMMONIA WITH RESPECT TO SENSORY ATTRIBUTES ARE DISCUSSED BELOW:

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AMMONIA AS AN AMELIORANT

RT CAN BE USED TO PROVIDE MOLECULAR AMMONIA INTO SMOKE. WHAT AMMONIA DOES IS THAT IT REACTS WITH SOME OF THE KNOWN IRRITANTS IN SMOKE AND CONVERTS THEM INTO NEW COMPOUNDS WHICH ARE NOT IRRITANTS. SUCH REACTIONS CAN OCCUR IN THE COAL OF A BURNING CIGARETTE OR EVEN AFTER THE SMOKE IS GENERATED. THIS IS HOW AMMONIA ACTS AS AN AMELIORANT.

AMMONIA AS IMPACT BOOSTER

AMMONIA, WHEN ADDED TO A TOBACCO BLEND, REACTS WITH THE INDIGENOUS NICOTINE SALTS AND LIBERATES FREE NICOTINE. AS A RESULT OF SUCH CHANGE, THE RATIO OF EXTRACTABLE NICOTINE TO BOUND NICOTINE IN THE SMOKE

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MAY BE ALTERED IN FAVOR OF EXTRACTABLE NICOTINE. AS WE KNOW, EXTRACTABLE NICOTINE CONTRIBUTES TO IMPACT IN CIGARETTE SMOKE AND THIS IS HOW AMMONIA CAN ACT AS AN IMPACT BOOSTER.

AMMONIA AS FLAVOR PROMOTER

AS MENTIONED ABOVE, AMMONIA LIBERATES ADDITIONAL FLAVOR COMPOUNDS, INCLUDING FREE NICOTINE, FROM THE BLEND. BECAUSE OF THIS PHENOMENON, SUCH COMPOUNDS CAN TRANSFER MORE EFFICIENTLY INTO THE SMOKE. THIS MEANS THAT, AT THE SAME BLEND ALKALOID CONTENT, A CIGARETTE INCORPORATING RT WILL DELIVER MORE FLAVOR COMPOUNDS, INCLUDING NICOTINE, INTO SMOKE THAN ONE WITHOUT IT.

AMMONIA AS TOBACCO TASTE ENHANCER

AS MENTIONED IN THE INTRODUCTION, THROUGH RT WE ENHANCE WHAT IS ALREADY PRESENT IN TOBACCO. AS WE ALL KNOW, ALL TOBACCOS REQUIRE CERTAIN PERIODS OF MINIMUM AGING TO DEVELOP FULL TASTE AND FLAVOR POTENTIAL. DURING THIS AGING PROCESS, REACTIONS TAKE PLACE THAT ARE SIMILAR TO THOSE THAT OCCUR IN CERTAIN RT'S. THROUGH PROCESS CONTROL, IT IS POSSIBLE TO ACCELERATE SUCH REACTIONS IN RT, RESULTING IN HIGHER

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CONCENTRATIONS OF MATERIALS SIMILAR TO THOSE NATURALLY OCCURRING IN TOBACCO AND CONTRIBUTE TO THE TOBACCO TASTE AND FLAVOR. AS A MATTER OF FACT, PYROLYSIS STUDIES HAVE SHOWN THAT PYROLYSIS OF CERTAIN SUGAR/AMMONIA REACTION POLYMERS PRODUCE MANY COMPOUNDS ASSOCIATED WITH THE FLAVOR OF BURLEY TOBACCO SMOKE. WE BELIEVE THAT BECAUSE OF THIS EFFECT, THERE IS AN ENHANCEMENT OF THE TOBACCO TASTE THROUGH USE OF RT.

FROM THE FOREGOING DISCUSSIONS, ONE MIGHT HASTEN TO CONCLUDE THAT ADDING SOME AMMONIA TO TOBACCO WOULD BE THE PANACEA TO CORRECTING ANY IRRITATION PROBLEM OR LACK OF TOBACCO TASTE. THAT IS NOT SO. AMMONIA IS EXTREMELY VOLATILE AND IS A GAS AT ROOM TEMPERATURE (BOILING POINT - 33.4 C). THEREFORE, IF ADDED AS AMMONIA, PER SE, IT WOULD BE LOST FROM THE TOBACCO FAIRLY QUICKLY. THE SECRET TO USING RT IS TO USE IT IN THE FORM OF MORE STABLE COMPOUNDS SUCH AS DAP OR UREA, WHERE HEAT WILL TRIGGER THE RELEASE OF AMMONIA. A BETTER APPROACH IS THROUGH PRIOR REACTION WITH TOBACCO SUCH THAT AMMONIA CAN REMAIN "BONDED" THROUGH CHEMICAL REACTIONS AND BE RELEASED BY THE ACTION OF HEAT.

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DEPENDING ON THE NATURE OF THE COMPOUND USED AS AMMONIA SOURCE, THE SMOKE SENSORY QUALITY WILL VARY.

WITH THIS BACKGROUND, THE SMOKE SENSORY QUALITIES OF VARIOUS VEHICLES OF AMMONIA INCORPORATION ARE GIVEN BELOW. IN DISCUSSING THE SENSORY ATTRIBUTES, REFERENCE WILL BE MADE BY THE FOREGOING DISCUSSIONS TO RELATE THE SMOKE SENSORY ATTRIBUTE OF EACH VEHICLE TO A SPECIFIC FUNCTION OF AMMONIA.

CPCL

IT IS A SHEET CAST RECONSTITUTED TOBACCO MADE BY DIGESTING TOBACCO BY-PRODUCTS WITH AMMONIA AND DAP. ALTHOUGH IT IS A RECONSTITUTED TOBACCO, UNLIKE ANY OTHER TRADITIONAL RECONSTITUTED TOBACCOS, IT IS NOT ONLY AN IMPORTANT VEHICLE FOR AMMONIA INCORPORATION, IT ALSO SERVES AS TOBACCO TASTE ENHANCER BECAUSE OF THE PRESENCE OF FLAVOR PRECURSORS SIMILAR TO THOSE PRESENT NATURALLY IN TOBACCO.

THE SMOKE SENSORY QUALITY OF CIGARETTES MADE ENTIRELY FROM CPCL HAVE MEDIUM IMPACT, LOW IRRITATION, GOOD MOUTHFEEL AND BODY AND ALSO HAS A

CHARACTERISTIC SWEETNESS IN THE SMOKE. THE SMOKE FLAVOR PROFILE IS DIFFERENT FROM ANY OTHER TOBACCOS BUT CAN BE BROADLY CLASSIFIED AS AIR-CURED WITH SOME SIMILARITIES TO BURLEY TOBACCO.

IN A BLEND CONTAINING 7-10% CPCL, IT IMPARTS SOME OF THE BENEFITS MENTIONED ABOVE. FOR EXAMPLE, A CIGARETTE CONTAINING 9% CPCL HAS HIGHER IMPACT, LOWER IRRITATION, BETTER BODY AND MOUTHFEEL, BETTER TOBACCO TASTE (TOASTED) AND SLIGHTLY MORE SWEETNESS IN SMOKE THAN THE SAME BLEND WITHOUT CPCL. SO, CPCL OFFERS ALL THE FOUR BENEFITS OF BY DISCUSSED EARLIER.

SMOKE ANALYSES OF 100% CPCL AND OF CIGARETTES CONTAINING VARYING LEVELS OF CPCL IN A TYPICAL AMERICAN BLEND, ARE GIVEN IN THE ATTACHED TABLE. OF PARTICULAR INTEREST IN THESE RESULTS ARE THE NICOTINE TRANSFER EFFICIENCIES. THE RESULTS SHOW THAT 100% CPCL CIGARETTES HAVE UNUSUALLY HIGH NICOTINE TRANSFER EFFICIENCIES OF 22% AGAINST NORMAL VALUES OF 12-15% FOR TOBACCOS. ALSO, IN THE BLENDS CONTAINING CPCL, THE NICOTINE TRANSFER EFFICIENCY PROGRESSIVELY GOES UP WITH INCREASING LEVELS OF CPCL.

EBR

EBR STANDS FOR EXTRACTED BURLEY RECONSTITUTED TOBACCO AND IS MADE BY THE PAPER PROCESS. IT WAS DEVELOPED AS A VEHICLE FOR USING BURLEY STEM IN THE FORM OF RECONSTITUTED TOBACCO. THE FURNISH, THEREFORE, IS HEAVILY SKEWED TOWARDS BURLEY STEM. IN EBR MANUFACTURE, THERE IS NOT NEARLY AS MUCH REACTION OF THE AMMONIA SOURCE WITH TOBACCO INGREDIENTS AND, THEREFORE, THERE ARE NOT ENOUGH REACTION PRODUCTS FORMED TO ENHANCE THE TOBACCO TASTE AS DOES CPCL.

CIGARETTES MADE ENTIRELY FROM EBR HAVE MODERATE IRRITATION, LOW IMPACT, SLIGHT BODY, AND ALSO HAVE SLIGHTLY STEMMY CHARACTER. THE VALUE OF EBR LIES In THE FACT THAT IT IS A SIGNIFICANT IMPROVEMENT OVER CIGARETTES CONTAINING EQUIVALENT PROPORTIONS OF

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PROCESSED STEM AS IS USED IN THE BBR FURNISH. IN A BLEND, IT ACTS MORE LIKE A FILLER TOBACCO. FOR EXAMPLE, AT 15% INCLUSION LEVEL, BBR REDUCES THE HARSHNESS AND IMPARTS SLIGHT BODY BY SUPPLYING AMMONIA TO THE BLEND, HOWEVER, IT DOES NOT SIGNIFICANTLY AFFECT THE TOBACCO TASTE.

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DAP

AS INDICATED EARLIER, THE CHEMICAL NAME IS DIAMMONIUM PHOSPHATE. THIS IS A FAIRLY STABLE SOURCE OF AMMONIA, ALTHOUGH, IT SHOULD BE RECOGNIZED THAT EVEN DAP ON EXPOSURE TO AIR CAN LOSE AS MUCH AS [illegible] OF THE AVAILABLE AMMONIA. DAP HAS APPROXIMATELY 26% AVAILABLE AMMONIA. SINCE DAP CAN ONLY PROVIDE AMMONIA, IT CAN ACT ONLY AS AMELIORANT, IMPACT BOOSTER, AND SATISFACTION PROMOTER.

TYPICALLY, WHEN USING DAP BY ITSELF ON LAMINA, IT IS USED FROM 0.4% TO 1%. AT LOW LEVELS (AROUND 0.5%) IT HELPS TO REDUCE THE PEPPERY IRRITATION NORMALLY ASSOCIATED WITH FLUE-CURED TOBACCOS. THERE IS A JUST PERCEPTIBLE INCREASE IN IMPACT. AS EXPECTED, IT DOES NOT HAVE ANY EFFECT ON THE TOBACCO TASTE. AT HIGHER LEVELS, (BEYOND 1%) IT IMPARTS A METALLIC OFF-TASTE.

EMERGE

THIS IS A BATCF DEVELOPMENT AIMED AT INCORPORATING AMMONIA IN THE FORM OF SALTS OF ORGANIC ACIDS. IT IS DESIGNED TO BE SPECIFICALLY APPLIED TO LOW ALKALOID

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COMPONENTS OF THE BLEND SUCH AS WTS OR RECONSTITUTED TOBACCO.

SINCE THIS ADDITIVE ONLY SUPPLIES AMMONIA TO THE BLEND, IT IS EXPECTED TO ACT AS AN AMELIORANT AND IMPACT BOOSTER. IN A TYPICAL AMERICAN BLEND, AT 2% INCLUSION LEVEL, IT REDUCES THE HARSHNESS AND IRRITATION, BUT AT THE SAME TIME IT REPRESSES THE TOBACCO TASTE.

HOWEVER, IN GERMAN TYPE BLENDS, EMERGE HAS BEEN FOUND TO REDUCE STRENGTH, IRRITATION, AND ACRIDNESS WITHOUT AFFECTING THE MOUTHFULNESS. IT ALSO IMPROVES THE AFTERTASTE BY REDUCING THE BITTERNESS.

FOR FURTHER INFORMATION, PLEASE CONTACT BATCF.

ANGIRO

THIS IS A SOUZA CRUZ DEVELOPMENT AND IS A REACTION FLAVOR MADE FROM BANANA EXTRACT AND AMMONIA. SINCE THE FLAVOR IS PREDOMINANTLY A REACTION PRODUCT BETWEEN SUGAR AND AMMONIA, IT SHOULD ACT AS A TOBACCO TASTE ENHANCER AND WOULD NOT HAVE A SIGNIFICANT

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EFFECT ON IMPACT AND IRRITATION.

AT 1.5% TO 3.0% ADDITION LEVEL ON A TYPICAL AMERICAN BLEND, IT IMPARTS BODY AND ENHANCES TOBACCO TASTE WITHOUT SIGNIFICANTLY AFFECTING THE REPORTED IMPACT AND IRRITATION. ON A BRAZILIAN

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BLEND. HOWEVER, SOUZA CRUZ FOUND THAT ANSIRO INCREASES BODY, ENHANCES TOASTED-ROASTED NOTES, IMPARTS A BURLEY SMOKE CHARACTER AND OTHER TYPICAL NOTES TO ROUND-OFF AND SMOOTHEN AMERICAN BLENDED AND VIRGINIA/BURLEY BLENDED CIGARETTE SMOKE". SOUZA CRUZ FURTHER FOUND THAT ANSIRO IN COMBINATION WITH AMMONIUM TARTRATE (ADDED TO WTS TO PROVIDE 1.35% AMMONIUM TARTRATE ON THE FINAL BLEND) DECREASES IRRITATION IN ADDITION TO THE BENEFITS OFFERED BY ANSIRO AS DESCRIBED PREVIOUSLY.

ANSIRO IS USED AS A CASING INGREDIENT FOR FLUE-CURED TOBACCOS. TOBACCOS TREATED WITH ANSIRO SHOULD NOT BE EXPOSED TO TEMPERATURES BEYOND 160 F (71 C). FOR FURTHER INFORMATION, PLEASE CONTACT SOUZA CRUZ.

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TABLE 1
TYPICAL SMOKE ANALYSIS OF 100% CPCL CIGARETTES

TAR	MG/CIG)	20.2
PUFFS		15.1
NICOTINE	(MG/CIG)	0.78
FILTER EFFICIENCY	(%)	48.0
CARBON MONOXIDE	(MG/CIG)	23.8
TAR/NIC. RATIO		25.9
SMOKE pH		7.8
NICOTINE TRANSFER EFF.	(%)	22.2
TOBACCO WEIGHT	...G/CIG)	1180

TABLE 2
SMOKE ANALYSIS OF CIGARETTES CONTAINING VARYING LEVELS OF CPCL AND EBR

PERCENT IN BLEND		TAR	NICOTINE		NICOTINE	TAR/NIC.
CPCL	EBR	(MG)	(MG/CIG)	PUFFS	TRANS. EFF.	RATIO
0	17	16.7	1.14	9.7	14.87%	12.9
3	13	16.3	1.20	8.8	16.38%	13.6
9	9	16.1	1.26	8.8	16.87%	12.9
15	5	16.6	1.28	9.0	17.84%	13.0
17	0	16.7	1.29	9.2	18.16%	12.9

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SPECIFIC APPLICATIONS

INTRODUCTION

THE FOLLOWING DISCUSSIONS DEAL WITH SPECIFIC INSTRUCTIONS FOR EXPERIMENTING WITH EACH OF THE RT's DISCUSSED PREVIOUSLY. THE DISCUSSIONS ARE NECESSARILY GENERAL, AS THERE ARE NO SET RULES FOR IMPLEMENTING RT. RATHER, STARTING POINTS ARE GIVEN FOR EACH RT, AND THE LEAF BLENDER OR PRODUCT DEVELOPER WILL NEED TO PRODUCE EXPERIMENTAL SAMPLES TO DETERMINE THE BEST WAY TO IMPLEMENT THE RT CHOSEN. B&W WILL DISCUSS ANY QUESTIONS IN FURTHER DETAIL UPON REQUEST.

CPCL BLEND USE:

SUGGESTED STARTING LEVELS FOR EVALUATING CPCL IN A BLEND ARE 5%, 7.5%, AND 10%. AT B&W, CPCL IS USED AT LEVELS UP TO 10% IN

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BLENDS. LEVELS ABOVE THIS CAN RESULT IN AN "EARTHY" OFF-TASTE OR GIVE THE CIGARETTE A "FLAT" TASTE. FOR MARKETS NOT ACCUSTOMED TO THE INCLUSION OF AMMONIA, A 10% LEVEL MAY BE TOO HIGH. IN MARKETS USING MORE FILLER STYLE TOBACCOS, ONE MAY

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FIND THAT HIGHER LEVELS OF CPCL ARE NEEDED TO OBTAIN THE OPTIMUM SENSORY CHARACTERISTICS. THIS IS BASED ON THE FACT THAT CPCL SHOULD IMPROVE NICOTINE TRANSFER EFFICIENCY, WHICH SHOULD INCREASE SMOKER REPORTED SATISFACTION. ALSO, THE CPCL SHOULD IMPART MORE VOLATILE BASES TO THE SMOKE THEREBY INCREASING STRENGTH. THIS SHOULD BE EXPERIMENTED WITH TO DETERMINE THE PROPER INCLUSION LEVEL.

AT B&W, WE HAVE NO PRODUCTS WITH CPCL AS THE ONLY RECONSTITUTED TOBACCO. WE USE A MIX OF CPCL AND EBR (SEE CPCL/EBR COMBINATION SECTION FOR MORE DETAIL). SOME BAT COMPANIES ARE USING CPCL AS THE ONLY RECONSTITUTED TOBACCO IN THEIR BLENDS. THEY USE ABOUT 10% INCLUSION LEVELS.

IN OUR EXPERIENCE AT B&W, WE HAVE NOT SEEN A LOT OF VARIATION IN THE AMOUNT OF CPCL NEEDED AS THE FLUE-CURED/BURLEY RATIO CHANGES. MARKETS WITH VIRGINIA OR MODIFIED VIRGINIA PRODUCTS WILL NEED TO EVALUATE SEVERAL LEVELS TO OBTAIN THE OPTIMUM SENSORY CHARACTERISTICS.

AT B&W, THE CPCL IS INCLUDED WITH THE FLUE-CURED PORTION OF THE BLEND IN THE PRIMARY PROCESS, AND IS CASED WITH THE FLUE-CURED CASING. IT CAN ALSO BE ADDED TO THE REDRIED BURLEY PRIOR TO TOP DRESSING. DO NOT REDRY CPCL. REDRYING

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IS DETRIMENTAL TO PHYSICAL PROPERTIES AND FLAVOR CHARACTERISTICS OF CPCL.

CPCL IS PACKED IN T6B CONTAINERS HOLDING 160 NET KILOS OF CPCL.

EBR BLEND USE:

A RECOMMENDED STARTING POINT FOR SENSORY EVALUATION OF EBR IS 10 TO 15% IN THE BLEND. EBR CAN BE USED UP TO ANY LOGICAL RECONSTITUTED LEVEL IN A BLEND (20% MAXIMUM) WITHOUT ADVERSE EFFECTS. AT B&W WE HAVE PRODUCTS WITH ALL EBR AND WITH EBR/CPCL MIXTURES. EBR LEVELS RANGE FROM 8 TO 20% WITH THE LOWER LEVELS BEING USED IN COMBINATION WITH CPCL.

AS WITH CPCL, BE CAUTIOUS OF MAKING JUDGEMENTS ABOUT EBR AT HIGH LEVELS IN MARKETS NOT ACCUSTOMED TO THE INCLUSION OF AMMONIA.

FINAL OPTIMUM EBR LEVELS WILL DEPEND ON THE CURRENT STEM INCLUSION LEVEL AND OTHER BLEND COMPONENTS, SUCH AS FILLER TOBACCOS. ONE MAY NEED TO REDUCE THE STEM AND SOME SELECTED GRADES WHEN INCLUDING EBR. THIS HAS TO BE DETERMINED ON AN EXPERIMENTAL BASIS.

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AT B&W, THE EBR IS ADDED TO THE REDRIED BURLEY PRIOR TO TOP DRESSING, OR TO THE FLUE-CURED PORTION PRIOR TO CASING. AS WITH CPCL, DO NOT REDRY EBR.

EBR IS PACKED IN T6B CONTAINERS HOLDING 160 NET KILOS OF EBR.

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CPCL/EBR COMBINATIONS:

AT B&W, WE TYPICALLY USE A MIXTURE OF CPCL AND EBR IN OUR NON-MENTHOL FULL-FLAVOR AND LIGHTS PRODUCTS. AS ALREADY STATED, WE HAVE PRODUCTS WITH ALL EBR AND NO CPCL, BUT NO ALL CPCL PRODUCTS.

A "TYPICAL" B&W NONMENTHOL BLEND WILL CONTAIN 11% TOTAL RECONSTITUTED, WITH AN EBR/CPCL RATIO OF 60/40. THIS LEVEL AND RATIO ARE FOR KSB-TYPE PRODUCTS THAT ALSO INCLUDE 6% FLUE-CURED STEM. WE HAVE FOUND THIS TO BE THE OPTIMUM LEVEL ACROSS A RANGE OF FLUE-CURED/BURLEY RATIOS AND PRODUCT STYLES (I.E., FULL TASTE, LIGHTS, ULTRAS). ALSO, B&W USES RATHER FLAVORFUL GRADES OF TOBACCOS, AND FOR BLENDS HIGH IN FILLER STYLES, THE OPTIMUM USAGE LEVELS COULD BE DIFFERENT.

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FINAL EBR AND CPCL INCLUSION LEVELS WILL DEPEND ON CURRENT BLEND COMPONENTS SUCH AS STEM AND TYPES OF TOBACCOS (FILLER VS. FULL FLAVOR). LEVELS AND RATIOS MAY BE QUITE DIFFERENT WITH OTHER BLEND TYPES AND STEM LEVELS. ALSO, AS DISCUSSED IN THE CPCL SECTION, BLENDS WITH HIGH LEVELS OF FILLER TOBACCOS MAY REQUIRE MORE CPCL/EBR. IF A BLEND CURRENTLY HAS A HIGH STEM LEVEL, ONE MAY WANT TO EXPERIMENT WITH SUBSTITUTING CPCL AND/OR EBR FOR A PORTION OF THE STEM AS WELL AS A MIXTURE OF THE STEM AND LAMINA.

WHEN B&W BEGAN EVALUATING AMMONIATED RECONSTITUTED TOBACCOS, WE WERE USING ART (A RECONSTITUTED TOBACCO WITHOUT ANY AMMONIA ADDITIVES) AND A MIX OF LARGE FLUE-CURED AND BURLEY STEMS AS WTS (WATER TREATED STEMS). OUR FIRST STEP WAS TO PUT THE BURLEY STEMS IN THE RECONSTITUTED TOBACCO, AND USE ONLY FLUE-CURED STEM IN WTS. THE AMOUNT OF STEM ADDED TO THE BLEND WAS REDUCED TO ABOUT 6% AS A RESULT. THE RECONSTITUTED MIX WAS MANIPULATED TO GIVE THE DESIRED SENSORY CHARACTERISTICS. THE TABLE ON THE FOLLOWING PAGE SHOWS EXAMPLES OF TYPICAL NONMENTHOL BLENDS WITH DIFFERENT RECONSTITUTED TOBACCOS.

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	PERCENT (%) BLEND INCLUSION		
	BLEND WITHOUT AMMONIATED RECON	BLEND WITH EBR	BLEND WITH EBR/CPCL MIX
COMPONENT			
FLUE-CURED	24.7	24.7	24.7
BURLEY	23.7	23.7	23.7
ORIENTAL	18.3	18.3	18.3
EXPANDED TOBACCO	10.2	10.2	10.2
ART	12.1		
CPCL			8.9
EBR		16.7	7.8
FC WTS		6.4	6.4
BR/BOR WTS	11.0		

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IN EACH OF THESE BLENDS, CPCL IS CASED WITH THE FLUE-CURED AND ORIENTAL TOBACCOS, AND EBR IS TOP-DRESSED WITH THE REDRIED BURLEY TOBACCO. THESE AMMONIATED RECONS SHOULD NOT BE REDRIED, AND DO NOT REQUIRE THE HEAVY CASING NORMALLY APPLIED TO BURLEY TOBACCO. IN FACT, THE ONLY CASING REQUIRED ON THESE RECONS INCLUDES WATER AND HUMECTANTS AS PLASTICIZERS FOR AID IN PROCESSING.

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IN THESE EXAMPLES, THE FLUE-CURED AND BURLEY PORTIONS DID NOT CHANGE EXCEPT FOR THE ALL CPCL BLEND. WE HAVE FOUND IMPROVEMENTS IN SMOKE QUALITY WITHOUT ADJUSTING THE FLUE-CURED BURLEY RATIO AS ONE GOES FROM USING NO AMMONIATED RECONSTITUTED TO A BLEND USING ALL ??? AND FURTHER IMPROVEMENT WITH A EBR CPCL MIX. BLENDS USING DIFFERENT STYLES OF TOBACCOS FROM WHAT B&W USES (I.E., MORE FILLER STYLES) REQUIRE ADJUSTMENTS TO THE FLUE-CURED AND BURLEY MIX WHEN INCORPORATING AMMONIATED RECONSTITUTED. IT MAY ALSO BE POSSIBLE TO REDUCE THE LEVEL OF BURLEY TOBACCO IN THE BLEND WHEN USING RT RECONS (IN PARTICULAR, CPCL). THIS IS BECAUSE THESE RECONS TEND TO INCREASE THE BURLEY CHARACTER OF THE SMOKE. THIS MAY NOT BE POSSIBLE FOR ???? BLENDS, HOWEVER, AND EXPERIMENTATION WITH THE PARTICULAR BLEND IN QUESTION IS NECESSARY.

FOR OPTIMUM SENSORY CHARACTERISTICS WHEN ELIMINATING EBR, THE BURLEY PORTION IS INCREASED TO COMPENSATE FOR LESS AMMONIATED

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RECONSTITUTED. AS PREVIOUSLY STATED THE CPCL LEVEL REMAINS BELOW ??, EVEN IN A BLEND WITH NO OTHER RECONSTITUTED. ONE MAY FIND THAT WITH MORE FILLER STYLES OF TOBACCO, MORE CPCL CAN BE USED.

THE USE OF CPCL AND EBR IN MENTHOL PRODUCTS IS VERY LIMITED AT B&W. WE HAVE FOUND THAT THE NORMAL MENTHOL LEVELS USED AT B&W (0.? TO 0.5% FOR [illegible] FLAVOR PRODUCTS) ARE NOT COMPATIBLE WITH AMMONIATED RECONSTITUTED TOBACCOS. CAPRI MENTHOL AND THE KCOL XL EXPORTED TO JAPAN ARE THE ONLY B&W MENTHOL PRODUCTS THAT USE AMMONIATED RECONSTITUTED. KOOL XL HAS A LOW MENTHOL LEVEL COMPARED TO OUR OTHER MENTHOL PRODUCTS WHICH MAY EXPLAIN WHY IT IS ACCEPTABLE, AND THE DESIGN OF CAPRI PROBABLY HAS AN EFFECT ON IT. THE TARGET FOR CAPRI WAS VIRGINIA SLIMS, WHICH USES AMMONIA. WHEN TRYING EBR OR CPCL IN A MENTHOL PRODUCT, A SUGGESTED STARTING POINT WOULD BE ABOUT HALF THE LEVEL IN A NONMENTHOL PRODUCT (I.E., 5% EBR AND/OR 5% CPCL).

IN SUMMARY, THERE IS NO ONE QUICK AND SIMPLE RULE TO FOLLOW IN DETERMINING THE INCLUSION OF EBR AND/OR CPCL. B&W HAS BEEN SUCCESSFUL IN COMBINING THE MATERIALS IN A 60% EBR/40% CPCL RATIO INCLUDING AT 17% ALONG WITH 6% FLUE-CURED STEM IN OUR NONMENTHOL PRODUCTS. THE ADDITION OF EBR AND/OR CPCL SHOULD BE EXPERIMENTALLY DETERMINED BASED ON LOCAL TASTES.

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CIGARETTE DESIGN

THE USE OF CPCL AND/OR EBR DOES NOT HAVE A MAJOR IMPACT ON THE DESIGN OR CONSTRUCTION OF THE CIGARETTE. EBR AND CPCL CAN BE USED IN FULL-FLAVOR, LIGHTS OR ULTRA CIGARETTES. AN INCLUSION LEVEL OF 10% CPCL WILL TYPICALLY INCREASE THE MEASURED TAR DELIVERY OF A FULL-FLAVOR CIGARETTE 1 MG AND A LIGHTS CIGARETTE 0.5 MG. THE INCLUSION OF CPCL MAY ALSO REQUIRE AN INCREASE IN DENSITY (DEPENDING ON BLEND CONSTITUENTS REMOVED) IN ORDER TO MAINTAIN HARDNESS. THIS IS BECAUSE CPCL HAS LOWER FILLING POWER THAN OTHER BLEND COMPONENTS.

EMERGE (DESCRIPTION AND USAGE)

EMERGE IS A MEDIUM TO DARK YELLOW AQUEOUS SOLUTION DEVELOPED AND AVAILABLE EX BATCF. ALTHOUGH THE FORMULA IS PROPRIETARY, IN GENERAL TERMS IT CONTAINS A MIXTURE OF NON-VOLATILE ORGANIC ACIDS INHERENT ?? TOBACCO AND AMMONIUM HYDROXIDE. IT ALSO CONTAINS A POLYSACCHARIDE SOURCE TO PREVENT CRYSTALLIZATION. EMERGE CONTAINS

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7.5% OF 31% AQUEOUS AMMONIA AND HAS A WATER CONTENT OF APPROXIMATELY 50% (pH = 9.3). IT IS A STABLE MIXTURE AND WILL NOT REACT VIOLENTLY WITH WATER. IT IS SUPPLIED IN COATED METAL DRUMS AND SHOULD BE STORED IN SEALED CONTAINERS IN A COOL, DRY, WELL VENTILATED AREA, AWAY FROM IGNITION SOURCES (FLASH POINT = 97 C).

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REASONABLE CARE SHOULD BE TAKEN WHEN HANDLING, AS SPLASHES COULD CAUSE EYE AND SKIN IRRITATION. SPLASH-PROOF SAFETY GLASSES AND ??? RESISTANT GLOVES SHOULD BE WORN WHEN PROLONGED OR FREQUENT CONTACT COULD OCCUR.

SINCE DAP (AND CONSEQUENTLY EBR AND CPCL) IS NOT ALLOWED IN GERMANY, BATCF HAS DEVELOPED EMERGE AS A PRIMARY SOURCE OF AMMONIA CIGARETTES. ITS MECHANISM DIFFERS FROM EBR AND CPCL IN THAT NO SUGAR-AMMONIA REACTIONS ARE INVOLVED.

EMERGE IS CURRENTLY BEING USED BY BATCF AS A STEM ADDITIVE IN THEIR LUCKY STRIKE PRODUCTS FOR GERMANY AND ITALY. THE LEVEL OF USAGE IS SUCH THAT THE FINAL BLEND CONTAINS ABOUT 0.5% TO 1.0% OF EMERGE.

AS WITH OTHER RT MATERIALS, EMERGE IS APPLIED TO A LOW ALKALOID PORTION OF THE BLEND. IT CAN BE APPLIED AS AN ADDITIVE ON STEMS OF RECONSTITUTED, [redacted] BURLEY TOP DRESSING OR AS A FLUE-CURED CASING.

IT IS RECOMMENDED THAT CIGARETTES CONTAINING EMERGE BE ALLOWED TO AGE FROM 5 TO 10 [redacted] PRIOR TO SMOKING TO ALLOW SUFFICIENT TIME FOR AMMONIA MIGRATION AND NICOTINE TRANSFER TO OCCUR.

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DAP (DESCRIPTION AND USAGE)

DAP IS AN ODORLESS WHITE CRYSTALLINE POWDER, WHICH GRADUALLY LOSES ABOUT 8% AMMONIA WITH EXPOSURE TO AIR. THE LOSS IS ACCELERATED WITH INCREASING HEAT.

IT IS SUPPLIED IN FIBERGLASS DRUMS WITH POLYETHYLENE LINERS. ??? SHOULD BE STORED IN DRY, SEALED, CLEAN CONTAINERS.

DAP IS READILY SOLUBLE IN WATER (PH = 8). IT IS ESSENTIALLY INSOLUBLE IN ALCOHOL AND THUS IS APPLIED AS A CASING OR TOP DRESS????

NORMAL GOOD HOUSEKEEPING AND HANDLING SHOULD BE FOLLOWED. AFTER EXPOSURE, HANDS AND FACE SHOULD BE THOROUGHLY WASHED WITH WATER.

MIXING TANKS AND LINES SHOULD BE FLUSHED WITH VERY HOT WATER IMMEDIATELY AFTER USE. ALL EQUIPMENT SHOULD BE STAINLESS STEEL.

DAP IS USED AS A SOURCE OF AMMONIA FOR REACTION MIXTURES. USUALLY IT ??? REACTED WITH MONOSACCHARIDES, POLYSACCHARIDES, CORN SYRUP, OR CAR???? PRIOR TO APPLICATION TO TOBACCO COMPONENTS (EBR, CPCL).

IT CAN ALSO BE USED AS A SINGLE SOURCE OF AMMONIA FOR CIGARETTE PRODUCTS. IT IS USED ON SOME B&W LICENSED PRODUCTS.

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BECAUSE OF ITS LIMITED SOLUBILITY WITH ALCOHOL, IT IS NOT USED AS A FINAL FLAVOR MATERIAL. IN ADDITION, IT DOES NOT MIX WELL WITH

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OTHER CASING MATERIAL AND, THEREFORE, MUST BE APPLIED AS A SEPARATE INGREDIENT. IT CAN BE APPLIED AS A BURLEY CASING PRIOR TO CLO, AS FLUE-CURED CASING, OR AS A TOP DRESSING OVER THE ENTIRE LAMINA BLEND. THE NORMAL LEVEL OF USAGE AS A SINGLE INGREDIENT IS APPROXIMATELY 0.5% BASED ON THE FINAL BLEND.

ANSIRO (DESCRIPTION AND USAGE)

ANSIRO IS A DEVELOPMENT OF SOUZA CRUZ AND IS AVAILABLE DIRECTLY FROM THEM. IT USES AMMONIUM HYDROXIDE WITH A SPECIFIC FRUIT EXTRACT. THEREFORE, IT CONTAINS SOME SUGAR-AMMONIA REACTION PRODUCTS IN ADDITION TO BEING A SOURCE OF AMMONIA. IT IS A BROWN WATER-BASED LIQUID EASY TO HANDLE.

DEVELOPMENT WORK BY SOUZA CRUZ INCLUDED USING EXTRACTS OF VARIOUS FRUITS (INCLUDING PRUNE, PINEAPPLE, CASHEW, AND BANANA) AS A SUGAR SOURCE IN CONJUNCTION WITH AMMONIUM HYDROXIDE OR DAP. REACTION CONDITIONS WERE AT 90 C FOR ONE HOUR.

SINCE SOUZA CRUZ DOES NOT HAVE THE CAPABILITY FOR A RECONSTITUTED TOBACCO PROCESS, ANSIRO HAS BEEN APPLIED TO STEM OR AS A CASING MATERIAL. IF USED ON STEM, IT IS APPLIED PRIOR TO EXPANSION, AS

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FILLING POWER WOULD BE REDUCED IF APPLIED POST-EXPANSION. WHEN APPLIED AS A CASING MATERIAL, IT IS APPLIED TO THE FLUE-CURED RATHER THAN THE BURLEY, IF THE BURLEY IS TO BE REDRIED BECAUSE SOME LOSS DUE TO VOLATILIZATION MAY OCCUR IF HEATED OVER 60 C.

THROUGH THE USE OF FRUIT EXTRACTS, ANSIRO IMPARTS FLAVOR NOTES TO SMOKE AS THE NORMAL EFFECTS OF RT. RT IS EFFECTIVE IN REDUCING IRRITATION WITH A SOMEWHAT LOWER CONTRIBUTION TO BURLEY CHARACTER THAN THE AT USING DAP AND CPCL.

SOUZA CRUZ CURRENTLY USES ANSIRO (AMMONIUM HYDROXIDE WITH BANANA EXTRACT) IN HOLLYWOOD EXPORT, LUCKY STRIKE, CAPRI, AND BARCLAY. APPLIED RATE IS 1-2% BASED ON THE FINAL BLEND.

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REGULATIONS AND RESTRICTIONS

REGULATIONS

BROWN AND WILLIAMSON ADDITIVE USE IS GUIDED BY THE B&W ADDITIVES ADVISORY COMMITTEE. SIMILARLY, BATCO COMPANY ADDITIVE USE IS GUIDED BY THE BAT ADDITIVES AND MATERIALS GUIDANCE PANEL. BOTH THE B&W COMMITTEE AND THE BAT PANEL ENSURE THAT ALL ADDITIVES ARE IN COMPLIANCE WITH BAT GROUP POLICY. BOTH ALSO MAINTAIN A FULL AWARENESS OF LOCAL REGULATIONS.

IN MOST COUNTRIES, THERE ARE NO REGULATIONS GOVERNING TOBACCO ADDITIVES; NOR ARE THERE VOLUNTARY AGREEMENTS BETWEEN TOBACCO MANUFACTURERS AND THE GOVERNMENT REGARDING THE USE OF ADDITIVES. HOWEVER, GOVERNMENT REGULATION OF THE PRODUCT FROM COUNTRY TO COUNTRY IS EVOLVING AND ANY REPORT ON THE STATUS OF ADDITIVE REGULATIONS IN VARIOUS COUNTRIES IS SUBJECT TO DEVELOPMENTS. THE INFORMATION PROVIDED HERE IS ACCURATE TO THE BEST OF OUR KNOWLEDGE AS OF FEBRUARY 1, 1991.

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THE FOLLOWING COUNTRIES HAVE REGULATIONS GOVERNING THE USE OF TOBACCO ADDITIVES:

BELGIUM
CANADA
FRANCE
GERMANY
HONG KONG
SPAIN
SWEDEN
SWITZERLAND
TERRITORIES OF ABOVE

IN ADDITION, IN THE COUNTRIES LISTED ON THE FOLLOWING PAGE THE TOBACCO MANUFACTURERS HAVE VOLUNTARILY AGREED TO FOLLOW A SET OF GUIDELINES GOVERNING THE USE OF TOBACCO ADDITIVES. WHILE SUCH GUIDELINES ARE NOT LAW, NEVERTHELESS THEY ARE FOLLOWED AS IF THEY WERE THE LAW.

AUSTRIA (FOLLOW GERMAN REGULATIONS)
ENGLAND
FINLAND (ADDITIVES ON ANY OF GERMAN, U.S., U.K., OR FRENCH LISTS)
IRELAND (FOLLOW ENGLISH VOLUNTARY CONTROLS)
ITALY
JAPAN
LUXEMBOURG (FOLLOW BELGIUM REGULATIONS)
NETHERLANDS (FOLLOW FOOD REGULATIONS)
PORTUGAL (FOLLOW FOOD REGULATIONS)
TERRITORIES OF ABOVE

THERE ARE NO TOBACCO ADDITIVE REGULATIONS IN THE U.S. HOWEVER, IN 1984 A LAW WAS PASSED REQUIRING THAT MANUFACTURERS ANNUALLY REPORT TO THE GOVERNMENT A COMBINED LIST OF INGREDIENTS USED IN ALL BRANDS SOLD IN THE U.S. THIS INCLUDES PROCESSING AIDS AND ADDITIVES USED IN RECONSTITUTED TOBACCO.

FUTURE CONCERNS

ATTENTION SHOULD BE FOCUSSED ON EUROPE IN THE NEXT FEW YEARS BECAUSE THE DEVELOPMENT OF TOBACCO REGULATIONS FOR THE EUROPEAN SINGLE MARKET IS LIKELY TO INFLUENCE OTHER COUNTRIES WORLDWIDE. THE NEW EUROPEAN REGULATIONS WILL BECOME EFFECTIVE DECEMBER 31, 1992. A

PERIOD OF ONE YEAR THEREAFTER WILL BE ALLOWED TO BRING PRODUCTS INTO COMPLIANCE WITH THE NEW REGULATIONS. HOWEVER, THERE IS A POSSIBILITY THAT TOBACCO REGULATIONS MAY NOT BE FULLY DEVELOPED BY DECEMBER 31, 1992. IF THAT HAPPENS, NEW TOBACCO REGULATIONS ARE NOT LIKELY TO TAKE EFFECT UNTIL 1994.

IN MAY, 1988, THE CANADIAN PARLIAMENT ENACTED A LAW REQUIRING CIGARETTE MANUFACTURERS TO REPORT TO THE GOVERNMENT THE IDENTITY AND AMOUNTS OF ALL INGREDIENTS ADDED TO A CIGARETTE IN ITS MANUFACTURE. THIS IS TO BE DONE ON A BRAND-BY-BRAND BASIS; HOWEVER, NO REPORTING IS REQUIRED FOR MANUFACTURERS OR IMPORTERS WHOSE SALES ARE LESS THAN 1% OF THE MARKET.

A SIMILAR ATTEMPT WAS MADE IN FINLAND IN 1990 TO HAVE TOBACCO MANUFACTURERS REPORT INGREDIENTS AND QUANTITIES ON A BRAND-BY-BRAND BASIS. THE FINNISH GOVERNMENT HAS THUS FAR

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ACCEPTED THE CIGARETTE MANUFACTURERS' DISCLOSURE OF INGREDIENTS USED IN SUBSTANTIAL VOLUME AND REPRESENTATION THAT EVERY INGREDIENT USED IS ON EITHER THE GERMAN, FRENCH, U.K., OR U.S. LISTS.

IN 1990, THE SWISS GOVERNMENT MADE INQUIRIES OF THE TOBACCO INDUSTRY SUGGESTING THAT SWITZERLAND MAY BE CONSIDERING STRICTER TOBACCO ADDITIVE REGULATIONS.

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ALSO IN 1990, LEGISLATION WAS INTRODUCED IN THE U.S CONGRESS THAT WOULD HAVE REQUIRED MANUFACTURERS TO REPORT CIGARETTE INGREDIENTS ON A BRAND-BY-BRAND BASIS. THE PROPOSED LEGISLATION WOULD HAVE ESTABLISHED THE DEPARTMENT OF HEALTH AND HUMAN SERVICES AS AN EVALUATION CENTER, AND EMPOWERED IT TO BAN THE USE OF INGREDIENTS IT CONSIDERED TO BE UNSAFE. THE LEGISLATION FAILED TO BECOME LAW.

ON THE FOLLOWING PAGE IS A TABLE WHICH SUMMARIZES REGULATIONS OR RESTRICTIONS ON CURRENT BAT RT's.

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REGULATORY STATUS OF ROOT TECHNOLOGY PRODUCTS

COUNTRY (INCL TERR.)	CRYO	EBR	DAP	EMERGE	ANSIRO
AUSTRIA		X	X	3	3
BELGIUM					
CANADA					
ENGLAND			2		
FINLAND		X	X	3	3
FRANCE	4	4	1	4	4
GERMANY	X	X	X	3	3
HONG KONG					
IRELAND			2		
ITALY					
JAPAN					
LUXEMBOURG					
NETHERLANDS					
PORTUGAL					
SPAIN	X	X	X		
SWEDEN					
SWITZERLAND					

X NOT PERMITTED
1 USE RESTRICTED TO RECONSTITUTED TOBACCO
2 UP TO 4% PERMITTED
3 UP TO 25% RECONSTITUTED TOBACCO PERMITTED
4 CIGARETTE MUST CONTAIN 85% OR MORE TOBACCO

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ROOT TECHNOLOGY PATENTS

PATENTS ARE A SOURCE OF NEW TECHNOLOGY INFORMATION FOR THE PRODUCT DEVELOPER. BUT THE TECHNICAL PERSON CANNOT PASS JUDGEMENT ON WHETHER INFRINGEMENT MAY OCCUR. THIS IS A QUESTION THAT MUST BE ANSWERED BY A LAWYER FOR THE COMPANY WHICH MANUFACTURES OR DISTRIBUTES THE PRODUCT WHO IS FAMILIAR WITH THE LOCAL PATENT AND INTELLECTUAL PROPERTY LAW AND ITS ADMINISTRATION.

THE PERSON PREPARING A PATENT ATTEMPTS TO PROVIDE THE MINIMUM REQUIRED INFORMATION ABOUT THE INVENTION AND ITS BENEFITS. THUS, THE PATENTS MAY NOT CONTAIN SUFFICIENT INFORMATION TO BEST USE A

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PROCESS.

THE PROCEEDINGS OF THE SECOND AMMONIA CONFERENCE CONTAIN RT PATENTS PRESENTATIONS FROM TWO LABORATORIES R&D-8311-90, pp 122-145). THE ONLY FAIR DEGREE OF OVERLAP BETWEEN THESE LISTS IS LARGELY DUE TO VIRTUALLY IDENTICAL PATENTS BEING GRANTED IN MORE THAN ONE COUNTRY.

THE TABLES ON THE FOLLOWING PAGES LIST PATENTS THAT, ACCORDING TO OUR INFORMATION, INCLUDE REFERENCES TO RT AND THUS MIGHT AFFECT RT AS PRACTICED WITHIN THE BAT

ORGANIZATION. THE TABLES ARE PRESENTED TO AID YOUR UNDERSTANDING OF RT AND ITS PRACTICE, INCLUDING POSSIBLE LIMITATIONS. BECAUSE A LAWYER EXPERIENCED IN PATENTS SHOULD PROVIDE THE ADVICE ABOUT POTENTIAL INFRINGEMENT, WE DO NOT REPRESENT THAT ONE TABLE CONTAINS A COMPLETE LIST OF PATENTS WHICH MIGHT BE ASSERTED IN AN INFRINGEMENT ACTION AGAINST A PRODUCT UTILIZING RT. A LACK OF AN ASSIGNEE MEANS THAT THE PATENT WAS GRANTED TO A PERSON RATHER THAN BEING ASSIGNED TO A COMPANY.

TABLE 1

ROOT TECHNOLOGY PATENTS - TOBACCO APPLICATIONS

NUMBER	ASSIGNEE	TECHNICAL AREA
GB	1356411 PM	ACET PROCESS
US	3771533 PM	ACET PROCESS
US	4248252 PM	ACET PROCESS
US	4266562 PM	ACET PROCESS
[illegible]	[illegible] PM	ACET PROCESS
US	246975	NH3 + FERMENTED TOBACCO, THEN HEAT
US	3729009 [illegible]	ADD UREA TO PAPER RECON
[illegible]	3957060 B&W	ADD UREA TO TOBACCO
US	3782393	AMMONIUM SULFAMATE
US	1193554	AMMONIUM SULFAMATE ON CIGARETTE PAPER
GB	814820	AMMONIUM SULFAMATE ON CIGARETTE PAPER
[illegible]	583149 [illegible]GUSTA	AMMONIUM SO4 AND PO4 ON CIG PAPER
US	4532945 PM	CROSS LINK DAP + CITRIC ACID
US	3411514 PM	DAP IMPROVES STEM TASTE
GB	1341525 AMF	DAP ON TOBACCO FOR IMPROVED BURN
US	4072155 LOR	DAP CATALYST FOR STIFFNESS IMPROVEMENT
[illegible]	1859379 AM	ETHANOLAMINES AS CASINGS
US	4286606 PM	FLAVORS
US	4379464 PM	FLAVORS
[illegible]	4537204 PM	FLAVORS
US	4638816 PM	FLAVORS
US	4123592 PM	FLAVORS PENETRATION
[illegible]	4184495 PM	FLAVORS PENETRATION
US	3425425 PM	NH3 IN STEM CASINGS BEFORE PUFFING
[illegible]	2171986	NH3 SALTS, UREA ETC. ON PAPER
US	4607646 PM	NH3 TREATMENT OF TOBACCO
US	4628947 PM	NH3 TREATMENT OF TOBACCO
[illegible]	4744375 B&W	NH3 + TOBACCO
US	4825884 B&W	NH3 + TOBACCO
EP	11368 LOR	NICOTINE MIGRATION
US	4215706 LOR	NICOTINE MIGRATION
EP	162671 PM	PECTIN RELEASE
GB	1078667 TAMAG	PECTIN RELEASE
GB	1153120 WILLS	PECTIN RELEASE
GB	1218848 PM	PECTIN RELEASE
GB	1321179 PM	PECTIN RELEASE
US	3353541 PM	PECTIN RELEASE

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US	3386449	PM	PECTIN RELEASE
US	3409026	PM	PECTIN RELEASE
US	3420241	PM	PECTIN RELEASE
US	3435829	PM	PECTIN RELEASE
US	3483874	PM	PECTIN RELEASE
US	3499454	PM	PECTIN RELEASE
US	3746012	PM	PECTIN RELEASE
US	3760815	PM	PECTIN RELEASE
US	3762392		PECTIN RELEASE
US	3929141	TAMAG	PECTIN RELEASE
US	4674519	PM	PECTIN RELEASE

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TABLE 1 (TOBACCO APPLICATIONS - CONTINUED)

NUMBER	ASSIGNEE	TECHNICAL AREA
US	3842846	PM PUFFING
US	4646760	TAMAG PUFFING
US	4677994	B&W PUFFING
US	4700722	B&W PUFFING
AU	89/02227	QUICK AGING OF TOBACCO
US	283622	REMOVAL OF LIPIDS FROM TOBACCO
US	4827949	SUGAR + TOBACCO
GB	1362751	I.C.I. TOBACCO SUBSTITUTE
US	3529602	PM TOBACCO SUBSTITUTE
US	3545446	I.C.I. TOBACCO SUBSTITUTE
US	3924462	H&R TOBACCO SUBSTITUTE
US	3934594	TAMAG TOBACCO SUBSTITUTE
US	4019520	B&W TOBACCO SUBSTITUTE
US	4079742	PM TOBACCO SUBSTITUTE
US	4333484	PM TOBACCO SUBSTITUTE
US	4506684	PM TOBACCO SUBSTITUTE
US	4510950	PM TOBACCO SUBSTITUTE
EP	20[illegible]	PM TOBACCO + LIQ NH3
EP	153817	PM TOBACCO + NH3 + HEAT IN AUTOCLAVE
GB	2186783	B&W TOBACCO + NH3 + HEAT IN AUTOCLAVE
GB	2210547	B&W TOBACCO + NH3 + HEAT IN AUTOCLAVE
GB	2187077	B&W TOBACCO + NH3 + STEAM
CA	1927984	TRANSFER COFFEE VAPORS TO TOBACCO

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AMMONIA IS ALSO CITED IN A NUMBER OF DENICOTINIZATION PATENTS (TABLE 2). THE TOBACCO RESIDUE IS OFTEN LEFT WITH A HIGH AMMONIA CONTENT.

TABLE 2

ROOT TECHNOLOGY PATENTS - DENICOTINIZATION APPLICATIONS

NUMBER	ASSIGNEE	NUMBER	ASSIGNEE
EP 280817	PM	GB 969144	RJR
EP 325476	RJR	US 1577768	
GB 1269959	TAMAG	US 1719291	
GB 1288688	SEITA	US 2478483	USA
GB 234845		US 2822306	
GB 265427		US 3742692	SEITA
GB 302560		US 3821960	TAMAG
GB 351779		US 4821749	RJR

AMINO FILTERS (TABLE 3) ALSO ACCOMPLISH SOME OF THE TASTE OBJECTIVES OF RT.

TABLE 3

ROOT TECHNOLOGY PATENTS - FILTER APPLICATIONS

NUMBER	ASSIGNEE	NUMBER	ASSIGNEE

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GB 2020955A BAT	US 3828800 B&W
US 3340879 B&W	US 4022223 PM
US 3355317 DTG	US 4033361 B&W
US 3716063 B&W	US 4266561 B&W
US 3716500 B&W	US 4372329 BATCF

GLOSSARY OF TERMS

EVERY ORGANIZATION EVOLVES ITS OWN SET OF ACRONYMS AND ABBREVIATIONS TO FACILITATE INTERNAL COMMUNICATIONS. FOR EXAMPLE, CRS IS AN ACRONYM FOR CUT ROLLED STEMS, AND FURTHER IMPLIES THE PROCESS BY WHICH IT IS MADE. CRS IS THEN A THREE LETTER SHORTHAND TERM FOR WHAT WOULD OTHERWISE BE AT LEAST A PARAGRAPH. WHILE MOST READERS ALREADY KNOW MOST OF THE TERMS IN THIS GLOSSARY, DEFINITIONS ARE GIVEN TO ENSURE THAT EVERYONE WILL UNDERSTAND THE TERMS IN THE SAME MANNER.

APET A PHILIP MORRIS EXPANDED TOBACCO MADE WITH AMMONIUM CARBONATE AS THE EXPANSION AGENT.

ARAX A BAND-CAST (SEE BELOW) RECONSTITUTED TOBACCO MANUFACTURING PROCESS DEVELOPED BY IMASCO IN CANADA.

AMF AMERICAN MACHINE AND FOUNDRY Co.

ANSIRO A CASING MADE BY HEATING A 70% ALCOHOLIC EXTRACT OF BANANAS WITH AMMONIUM HYDROXIDE. THIS PRODUCT IS AVAILABLE FROM SOUZA CRUZ.

ART A NON-AMMONIATED RECONSTITUTED TOBACCO SIMILAR TO EBR.

BAND-CAST A PROCESS FOR MAKING RECONSTITUTED TOBACCO IN WHICH A SLURRY IS CAST ON A STAINLESS STEEL BAND AND THEN PASSED THROUGH A DRYING TUNNEL TO REMOVE WATER.

BATCF BAT CIGARETTENFABRIKEN

BINDER A FILM-FORMING, TACKY AGENT USED TO HOLD A THINGS TOGETHER. FOR EXAMPLE, NACMC OR SODIUM CARBOXYMETHYLCELLULOSE IS A COMMON BINDER IN RECONSTITUTED TOBACCO PATENTS.

B&W BROWN & WILLIAMSON TOBACCO CORPORATION

CEL CONCENTRATED EXTRACT LIQUOR. THIS IS ADDED TO THE FORMED FIBER WEB IN THE PAPER PROCESS FOR MANUFACTURING RECONSTITUTED TOBACCO.

CLD CASED LEAF DRYING.

CPCL A B&W RECONSTITUTED TOBACCO MADE BY THE BAND-CAST PROCESS. IT USES DAP IN THE STEM DIGESTION PART OF THE PROCESS TO RELEASE PECTIN BINDER.

CYTREL A TOBACCO SUBSTITUTE FROM CELANESE CO. THAT IS NO LONGER AVAILABLE.

DAP DIAMMONIUM PHOSPHATE

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DIET DRY ICE EXPANDED TOBACCO.

EBR A PAPER PROCESS (SEE BELOW) RECONSTITUTED TOBACCO AVAILABLE FROM B&W. IT CONTAINS DAP IN ITS FORMULATION.

EMERGE A CASING MADE FROM AMMONIUM SALTS OF MALIC, CITRIC, AND SOMETIMES PHOSPHORIC ACIDS. IT IS AVAILABLE FROM BATCF.

FURNISH THE TOBACCOS USED TO MAKE A GIVEN RECONSTITUTED TOBACCO.

H&R HAARMANN & REIMER CORP.

I.C.R. IMPERIAL CHEMICAL INDUSTRIES

K-C KIMBERLY-CLARK Co.

L&M LIGGETT & MYERS TOBACCO CORP.

LOR P. LORILLARD TOBACCO CORP.

MOOR MOORGATE RECONSTITUTED TOBACCO. THIS IS A HIGH STEM RECON THAT WAS PURCHASED FROM LORILLARD.

PAPER PROCESS - A METHOD OF MAKING RECONSTITUTED TOBACCO IN WHICH EXTRACTABLES REMOVED FROM THE TOBACCO FURNISH ARE CONCENTRATED AND ADDED BACK TO A PAPER BASE MADE FROM THE TOBACCO FURNISH FIBERS. THAT PART OF THE EXTRACT ORIGINATING FROM TOBACCO STEMS MAY BE DISCARDED IN SOME FORMULATIONS.

PECTIN A NATURALLY OCCURRING TOBACCO GUM WITH GOOD BINDING PROPERTIES. IN TOBACCO, IT OCCURS AS PROTOPECTIN, WHICH IS PECTIN CROSSLINKED BY CALCIUM AND MAGNESIUM.

PM PHILIP MORRIS TOBACCO CORP.

PROPYL PARABEN - AN ADDITIVE THAT RETARDS MICROBIAL GROWTH.

PYROLYSIS - DESTRUCTIVE DISTILLATION. THIS PROCESS ACCOUNTS FOR MOST CIGARETTE SMOKE FORMATION.

RCB A DESIGNATION WE USE FOR PM's CPCL-TYPE OF RECONSTITUTED TOBACCO.

RECON A GENERIC TERM FOR RECONSTITUTED TOBACCOS MADE BY ANY MANUFACTURING PROCESS.

RJR R. J. REYNOLDS TOBACCO CO.

RT ROOT TECHNOLOGY

SEITA FRENCH TOBACCO MONOPOLY

SLURRY PROCESS - SAME AS BAND-CAST PROCESS FOR MANUFACTURE OF RECONSTITUTED TOBACCO.

T6B A STANDARD SIZE/SPACE CARDBOARD SHIPPING BOX.

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TOP DRESSING - AT B&W THE TOP DRESSING IS A SUPPLEMENTARY CASING APPLIED TO ALREADY CASED/REDRIED BURLEY TOBACCO. THIS PRECEDES THE CUTTING AND LAMINA DRYING OPERATIONS.

USA UNITED STATES OF AMERICA

WTS A MODERATELY EXPANDED STEM PRODUCT MADE BY RAISING CUT-ROLLED-STEM (CRS) TO HIGH MOISTURE AND THEN DRYING.

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